ECONOMIC AND SOCIAL SUSTAINABILITY OF SIDEWALK INFRASTRUCTURE

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Deep Shyamsundar Patel

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ECONOMIC AND SOCIAL SUSTAINABILITY

OF SIDEWALK INFRASTRUCTURE

Approved by:

Dr. Randall L. Guensler, Advisor
School of Civil and Environmental Engineering
Georgia Institute of Technology

Dr. Michael O. Rodgers
School of Civil and Environmental Engineering
Georgia Institute of Technology

Dr. Tim Welch
School of City and Regional Planning
Georgia Institute of Technology

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF SYMBOLS AND ABBREVIATIONS

ADA	Americans with Disabilities Act
ADAAG	ADA Accessibility Guidelines
DOT	Department of Transportation
EAC	Equivalent Annual Cost
GIS	Geographic Information System
ISTEA	Intermodal Surface Transportation Efficiency Act
NPV	Net Present Value
PDI	Pedestrian Deficiency Index
PPI	Pedestrian Potential Index
SPI	Sidewalk Priority Index
SRI	Sidewalk Repair Index
TEA - 21	Transportation Equity Act for 21st Century
TSPLOST	Transportation Special Purpose Local Option Sales Tax
USDOT	U.S. Department of Transportation

SUMMARY

The presence of sidewalks and quality of sidewalk infrastructure are important indicators of perceived pedestrian safety and the walkability of neighborhoods. However, a wide gap exists between the accessibility and quality of infrastructure provided for pedestrians compared to the infrastructure provided for motorized vehicles. While there may be numerous reasons for poor quality of pedestrian infrastructure across cities and neighborhoods, one of the main reasons is the lack of sustained operation and maintenance programs among these local government agencies. This study outlines an approach to quantify sidewalk infrastructure costs over an 80-year life cycle period. Equivalent annual costs for three different scenarios are allocated in part directly to property owners, with the remaining costs in each scenario recovered over time through an equivalent increase in property tax millage rates. The four sidewalk management scenarios are then examined in more detail to assess how implementation may differentially impact Atlanta's 244 neighborhoods and their residents across income and ethnicity groups. The two somewhat surprising findings of the study are: 1) even though sidewalk infrastructure may have a lifespan of more than 40-years, the costs of owning and operating this infrastructure over an 80-year period with replacement are high; and 2) low income neighborhoods are negatively impacted when portions of sidewalk infrastructure management costs are allocated directly to property owners, rather than handling sustainable management through traditional property tax assessment methods.

CHAPTER 1. INTRODUCTION

Of all the numerous types of built environment, the sidewalk is one of the most influential infrastructures for humans, it supports pedestrian travel as well as healthy pedestrian activity (1). The quality of sidewalks is an important indicator of perceived safety and quality of walkable neighborhood (2). However, there is currently a wide gap between the accessibility and quality of pedestrian infrastructure compared to that of motorized vehicles (3-5).

Many communities suffer from discontinuous pedestrian infrastructure and poor maintenance, making sidewalks inaccessible to those with physical disabilities (4). Sidewalk users are diverse in terms of age, gender, and physical condition; hence, it is necessary to design sidewalk that serve the entire spectrum of people (6). Regulations under the Americans with Disabilities Act (ADA), have been enacted to ensure that pedestrian infrastructure is accessible to members to the disability community (10). However, it is also important to ensure that sidewalk accommodate all individuals, irrespective of their socio-economic conditions, to facilitate equitable accessibility and mobility on pedestrian facilities.

Recently, three wheelchair users filed a lawsuit in Atlanta alleging many of the public sidewalks in the city are in poor condition and are not up to the ADA standards (7). Similar lawsuits have been filed against the cities of Portland, Oregon, Los Angeles, Seattle, New York City, and others (7). While there may be numerous reasons for poor quality pedestrian infrastructure within different neighborhoods, one of the main reasons is the lack of serious maintenance programs among these local government agencies. This results

from a lack of adequate, sustainable, and equitable sources of funding for sidewalk infrastructure maintenance (8). Municipal governments across the nation maintain and repair roads and highways; however, most cities require adjacent property owners to maintain the sidewalks (4).

The motivation for the research presented in the thesis comes from realization that sidewalk infrastructure has a significant role in creating a healthy walkable community and that there is currently a lack of maintenance programs in most cities in the nation (4). This thesis outlines an approach to estimate infrastructure costs for implementation of sustainable sidewalk systems, where sidewalk life extends into perpetuity and presents different funding options to develop a sustainable sidewalk maintenance program for the City of Atlanta.

This thesis is organized major topics affecting the economic and social sustainability of the sidewalk systems, and their associated analytical activities applied to the City of Atlanta. Chapter 2 provides a background on sidewalk infrastructure requirements and challenges faced by the government agencies for public sidewalk maintenance. Chapter 3 evaluates the construction, maintenance, and removal costs associated with the sidewalk infrastructure. Chapter 4 analyzes the potential equity aspects of public sidewalks by looking into sidewalk infrastructure across Atlanta neighborhoods and associating the infrastructure costs with income and ethnic groups of the neighborhood. Chapter 5 presents case studies on sidewalk maintenance programs employed by different cities across the country and offers recommendations to create a sustainable sidewalk maintenance program for the City of Atlanta, followed by concluding remarks in Chapter 6.

CHAPTER 2. LITERATURE REVIEW

Increasing the share of trips made using active modes of transportation can provide many benefits including physical activity, travel cost savings, lower greenhouse gas emissions and consumption of non-renewable energy, reduced infrastructure costs, and enhance community interactions (9). However, cities choose to address sidewalk infrastructure in many different ways. Some cities see the public sidewalks as the responsibility of adjacent sidewalk owners, other cities take on the burden of ownership and management of sidewalks, and many cities share the responsibility between the city and private property owners (with many different rules being implemented to prescribe these arrangements).

This chapter provides an overview of Americans with Disability Act (ADA), challenges faced by cities in enhancing sidewalk accessibility, and an introduction to equity aspect in sidewalk infrastructure.

2.1 The Americans with Disabilities Act

The Americans with Disabilities Act (ADA) of 1990 protects the civil rights of people with disabilities; the 1991 reauthorization of Federal transportation legislation, the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA), proposed integration of pedestrian travel into the transportation system; and the Transportation Equity Act for 21st Century (TEA – 21) increased the funding availability for pedestrian facilities (10).

The ADA aims to reduce the frequency of unemployment and isolation of disabled persons and to make society as a whole more accessible for those with disabilities (11).

The U.S. Access Board (USAB) published the first definitive ADA Accessibility Guidelines (ADAAG) addressing the accessibility in pedestrian infrastructure design (11). The various iterations of the ADAAG design standards are incorporated by reference to Title 28 of the Code of Federal Regulations (28 CFR 305.104 and 28 CFR 35.151(c)) (11).

A summary of ADAAG specified criteria for widths, surface condition, grade, and cross slope for all accessible routes including sidewalks are presented in Table 1 (12,13). The sidewalk standards in Table 1 also apply to ramps at the crosswalks, except the maximum ramp slope allowed for ramps are 8.33% as compared to 5% for the sidewalks as presented in Table 2. (14). These federal guidelines for accessible design under ADA apply to all federal, state, and local activities. These are the minimum requirements, state and local agencies are free to adopt design guidelines that provide greater accessibility. For example, the City of Atlanta requires 60-inch sidewalks, while the Florida DOT requires 48-inch sidewalks with 12-inch buffer strips. (14)

Table 1. Standard for Sidewalk Design Features (14)

Sidewalk Design Feature	Federal Standards (ADAAG)
Clear Sidewalk Width	• 36 inches minimum • If the width is less than 60 inch width, a 60-inch by 60-inch passing space must be provided every 200 feet
Running Slope	• 5% maximum slope or equal to roadway slope
Cross-Slope	• 2% maximum cross-slope
Obstructions	• No obstructions may be present within the pedestrian access route
Pavement material	• Surface must be “firm,” “stable,” and “slip-resistant”

Table 1. Standard for Sidewalk Design Features

Changes in Level	• Vertical displacements up to 1/4 inch are allowed • Vertical displacements from 1/4 to 1/2 inch must be beveled to a slope no greater than 1:2 • Vertical changes greater than 1/2 inch must be smoothed so as not to exceed a ramp slope of 8.33%
Vertical Clearance	• 80 inches minimum vertical clearance

Table 2. Standards for Ramp Design Features (12,13)

Sidewalk Design Feature	**Federal Standards (ADAAG)**
Clear Ramp Width	• 36 inches minimum (same as the value for sidewalks)
Passing Area on the Top Ramp Landing	• 36 inches behind ramp
Ramp Running Slope	• 8.33% maximum slope
Ramp Cross-Slope	• 2% maximum cross-slope (same as the value for sidewalks)
Gutter Slope	• 5% maximum slope from the bottom of the ramp up into the street (in the direction of wheelchair travel)
Ramp Obstructions	• No obstructions may be present within the pedestrian access route
Ramp Pavement Material	• Surface must be “firm,” “stable,” and “slip-resistant”

Table 2. Standards for Ramp Design Features

Changes in Level on Ramp and at Ramp Transitions: Street to Gutter Gutter to Ramp Ramp to Sidewalk	• Vertical displacements up to 1/4 inch are allowed • Vertical displacements from 1/4 to 1/2 inch must be beveled to a slope no greater than 1:2 • Vertical changes greater than 1/2 inch must be smoothed so as not to exceed a 5% slope
Vertical Clearance	• 80 inches minimum vertical clearance
Detectable Warning Surface (DWS) Present	• Detectable warning surface must be present
Ramp Bottom Landing (applicable only to parallel and combination ramps)	• 60" minimum in width • 2% maximum running slope

2.2 Sidewalk Infrastructure

While motor vehicles occupant safety has made considerable progress, pedestrian fatalities are on the rise, making up greater portion of all traffic fatalities each year. Pedestrian-related crashes accounted for almost 12% of all traffic fatalities in United States, amounting to more than 49,000 deaths the last decade (15). A more safe and complete walking environment can significantly reduce the number of fatalities and injuries experienced by the pedestrians (16). Pedestrian mobility and sidewalk accessibility face numerous challenges. These challenges include (17):

- Lack of pedestrian activity
- Lack of sidewalk maintenance

- Lack of pedestrian planning
- Lack of political and financial support for pedestrian planning

In 1994, the U.S. Department of Transportation (USDOT) stated the goal of doubling the percentage of people who walks and bicycles as their mode of travel and reducing the number of injuries of pedestrian and bicyclists injured in traffic accident by 10% (18). Cities with large pedestrian and bicycling population such as Portland, OR, and Boulder, CO have developed several pedestrian and bicycle plans along with significant investments in sidewalks and biking routes (19)

Pedestrian infrastructure systems are perceived as key to societal and economic functions (3). Pedestrian infrastructure can be costly and difficult to construct and repair in an era of tight budgets, but failure to invest in pedestrian infrastructure can lead to serious consequences (20). Cities often defer or neglect pedestrian infrastructure maintenance, and there is little systematic implementation of approaches to manage pedestrian infrastructure management in most cities (21). New systems are needed that will help quantify the total costs of owning and operating pedestrian infrastructure (30) and equitably allocate these costs to stakeholders.

Apart from safety, health, and accessibility issues, sidewalk quality has legal implications as well. Because sidewalks are legally considered as part of public right of way, local government can be held liable for "Trip and Fall" injuries resulting from lack of pedestrian infrastructure maintenance. Recent court decisions indicate that municipalities are responsible for removing barrier to reasonable accessibility. For example, Los Angeles

settles an ADA class action lawsuit in 2015 and agreed to invest $1.4 billion over 30 years to build curb ramps and repair the sidewalks (22).

Although citizens often call for sidewalk improvements, the typical policy response is to provide city funds or require private owners to develop and improve sidewalks in public areas (23,24). Such policies may improve walkability but do not address long-term maintenance issues, resulting in poorly maintained sidewalks that discourage pedestrian activities.

A survey of 82 cities in 45 states found that 40% of the cities require property owners to pay the full cost of sidewalk maintenance, 46% share the cost with property owners, and only 13% of cities pay the full cost of sidewalk maintenance (4). Of course, even when cities "pay" for the cost of sidewalks, it is important to keep in mind that the property owners actually pay for these sidewalks through property tax revenues. Even when the responsibility for sidewalk maintenance is taken by a city, some sidewalks are maintained in good condition, while others fall into a state of disrepair (3). Infrastructure condition assessment is necessary to provide important information to decision makers to monitor the quality, which is essential for maintenance actions.

Transportation planning has typically focused on roads and highways. Pedestrian facilities are often considered recreational amenities rather than a transportation mode, and have often been ignored in the transportation planning process (3). Pedestrian planning has been on the rise over the last decade, as complete streets and transit-oriented development have caught on throughout the nation (25). A successful pedestrian

transportation plan can be best achieved through a comprehensive planning in which pedestrian concerns are integrated into local planning and design.

Many factors may prevent community members from using existing pedestrian infrastructure. The availability of sidewalk infrastructure, complete connectivity from origin to destination, sidewalk quality, safety concerns, and other factors may make it difficult for people to walk from place to place. Such factors discourage people from walking, and the impacts especially impact people from disadvantaged communities, where the lack of transportation options and health problems are already a primary concern (26). Chapter 4 focuses on the equity aspect of sidewalk infrastructure based on ethnicity and income.

CHAPTER 3. PEDESTRIAN INFRASTRUCTURE COST

Since the early 20th century, federal funding for surface transportation has focused on vehicle roadways. The primary reason for the focus on roadways has been the initial development of the Interstate Highway system, followed by significant and ongoing deterioration of roadway surface infrastructure caused by trucks and automobiles. However, over the past few decades, the views of non-motorized mode and federal interest in promoting them have changed significantly. Pedestrian and bicycle infrastructure is recognized as an important component for a safe and effective transportation system (28).

Pedestrian infrastructure is often constructed in parallel with the original buildings or roads. However, while roadways receive continuous maintenance, pedestrian infrastructure often does not. Because foot traffic is very unlikely to cause significant damage to sidewalks, the damage to pedestrian infrastructure is often independent of its design use. Sustainable sidewalk management planning is essentially forgotten after sidewalks are built, especially given that the long life-cycle of sidewalks (around 40 years). Furthermore, sidewalks do not generate tax revenues, which makes the political decisions regarding funding mechanism for pedestrian infrastructure quite murky.

Before sustainable sidewalk policies can be developed, the life-cycle costs of pedestrian infrastructure management must be quantified. This chapter evaluates the total ongoing cost associated with pedestrian infrastructure in City of Atlanta. Total life-cycle costs include the initial infrastructure construction cost, infrastructure replacement costs every 40 years that account for natural system deterioration, as well as additional maintenance costs within 40-year life-cycle that are not associated with natural degradation

(e.g., damage from heavy vehicles, damage from tree root incursion, etc.). Any plan to install new sidewalks should consider all of these anticipated costs, provide funding sources for new construction, expected demolition and replacement, and long-term maintenance.

The initial construction costs and 40-year replacement costs associated with sidewalks are based on the sidewalk network generated by Sidewalk Lab at Georgia Tech and current costs provided from a literature review of contract costs. The maintenance costs associated with these sidewalks to repair un-anticipated damage during the 40-year lifespan are generalized from the evaluation of four major corridors in the City of Atlanta.

3.1 Estimating the Initial Cost of Basic Pedestrian Assets for the City of Atlanta

Pedestrian infrastructure is typically constructed at the time of construction of adjacent property or roadway as a complementary asset. Such projects are not usual, and once the pedestrian infrastructure is built, it continues to serve the community for decades. Once sidewalks are installed in a community, they benefit the community in terms of safety, mobility, and health. In most cities, local ordinances require that sidewalks be built by property developers, in compliance with the land use zoning. Policies also often require that pedestrian infrastructure features, if not already present, be built whenever transportation asset modification is required by a project. For example, if a property undergoes substantial changes including milling and overlay of adjacent pavements, adjacent sidewalks must be improved to meet ADA design requirement (28).

Several inputs must be calculated to estimate total cost of construction for sidewalks in City of Atlanta. First, the number of sidewalk miles must be calculated to estimate initial

construction costs, end-of-life-cycle replacement costs, and additional un-anticipated maintenance costs.

3.1.1 Sidewalks

Generation of a fully-connected sidewalk network generation is based on the parcels and roadway centerline data (29). It is important to note that this sidewalk network represents the sidewalk that are expected to exist, not necessarily the actual sidewalk that are present (29). For this thesis, we assume that the complete infrastructure has been constructed in Year 0 for life-cycle analysis. The sidewalk network for the City of Atlanta was generated by the Sidewalk Lab at Georgia Tech. The network is first divided into logical links that connect street crossings, and then subdivided into 50-foot sections for use in an asset management system (29). The sidewalk network generated for this thesis includes 3,145 miles of sidewalks for the City of Atlanta, shown in Figure 1. In reality, the city probably has close to 2,600 mile of sidewalk in place today, but this thesis will assess a comprehensive network of expected infrastructure.

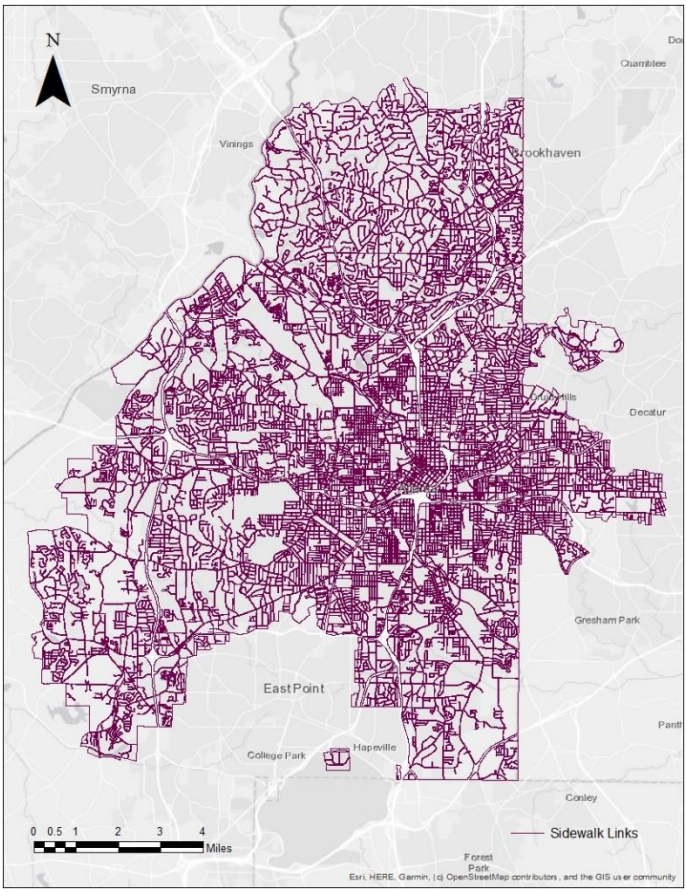

Figure 1. Sidewalk Network Map of Atlanta

3.1.2 Curb Ramps

The second pedestrian asset to be quantified is the number of pedestrian curb ramps serving street crossings. Intersections were identified from the sidewalk network. Each intersection corner should have zero, one, two, or sometimes more curb ramps, based on number of sidewalk and the type of the curb ramp used for design. So, if there are two sidewalk sections intersecting at a corner, two standard curb ramps are assumed to be present (i.e., eight curb ramps are assumed to be located at each four-way intersection roadways with sidewalks present on both the sides of the road). A total of 9,021 intersections were identified in the City of Atlanta and 27,006 crosswalk links were created

in ArcMap (29). A ramp node is assumed at the vertices of each of these crosswalks. A total of 54,012 curb ramps are estimated for the Atlanta sidewalk network.

3.1.3 Curb Cuts

Public sidewalks separate private property from adjacent public streets. As discussed earlier, the responsibility for maintenance of sidewalks and curb cuts varies from city to city. In most of the cities, the sidewalk and the curb cut are on public property (i.e., not part of the private property owner's surveyed parcel), but the maintenance and upkeep varies by municipality.

In contrast to sidewalks, which serve all members of the public, curb cuts or driveways are constructed to provide access to the private property for property owner, customers, and renters. From a public policy perspective, an effective argument can be raised that because the private owners are the sole benefactors of driveways and curb cuts, the costs of curb cut construction and maintenance ought to be borne by these private property owners. This issue will be raised again in the discussions of cost allocation and equity assessment later in this thesis.

The presence of a curb cut reduces the amount of sidewalk that must be maintained. To separate the cost of owning and operating sidewalks from the costs of curb cuts, it is necessary to know the number of curb cuts for all of the parcels in City of Atlanta. Curb cuts are not uniform in linear length and vary throughout the City as a function of land use and when the curb cuts were constructed. Studying each and every tax parcel to quantify the number of curb cuts and lengths is beyond the scope of this study; hence, a series of assumptions will be employed in this thesis. A sample set of major parcel class has been

studied to quantify the average number of curb cuts present across parcels, as well as the corresponding curb cut length.

To estimate the number of land use parcels associated with the sidewalk network, each sidewalk section is spatially joined to its adjacent tax parcel. Out of 165,480 total parcels, 98,604 parcels were associated with 343,219 sidewalk links. These parcels are divided into several categories, such as Residential, Commercial, Industrial, Utility, Historical, Exempt, etc. A sample set of residential, commercial, and industrial parcels were studied to quantify the average number of curb cuts and its length for each parcel. For all the other parcel classes, the number of curb cut is assumed to be one and curb cut length is assumed to be 10 feet, which is the minimum recommended width for a driveway by City of Atlanta. Using these assumptions, the effective sidewalk length consumed by curb cuts is approximately 340 miles, reducing the total sidewalk mileage to 2,804 miles. This means that approximately 10.8% of the initial sidewalk mileage estimate (340 miles out of 3145 miles) is composed of curb cuts. Table 3 provides the breakdown of curb cut miles and net remaining sidewalk miles by land use type.

Table 3. Curb Cut Length and Effective Sidewalk Length

	NUMBER OF PARCELS	SIDEWALK LINKS IN MILES	CURB CUT LENGTH	AVERAGE CURB CUTS PER PARCEL	TOTAL CURB CUTS	CURB CUT MILES	EFFECTIVE SIDEWALK MILES
COMMERCIAL	7460	490	28	1.3	9698	51	438
INDUSTRIAL	1423	120	60	1.3	1850	21	99
UTILITY	401	35	35	1.3	521	3	32
RESIDENTIAL	83785	1971	16	1	83785	254	1717
OTHER	5535	528	10	1	5535	10	518
TOTAL	98604	3145				340	2804

It is important to note that all of the cost estimates that will be presented in the chapters that follow will be for typical installations and repair work only. These costs do not include any significant engineering costs or unusual construction work. Costs associated with moving utilities, changing sewer inlet locations, making modifications to roadway and gutter conditions are very high, and are not included in these typical cost estimates.

3.1.4 Total Construction Costs of Ramps, Curb Cuts, and Sidewalks

For the purposes of this thesis, two costs scenarios are considered. Scenario 1 will include the costs related to pedestrian curb ramps, driveway curb cuts, and running sidewalk lengths, while Scenario 2 excludes the costs of the curb cuts, which we will assume have already been constructed by and will be maintained by the adjacent property owner.

3.1.4.1 Total Construction Cost of Ramps

The installation costs for a typical pedestrian ramp can range from $800 to nearly $2,000 (30). The variability in costs is associated with the difference in component costs for mobilization, concrete placement, traffic control (for concrete placement) (30). The estimated cost of construction for ramps is conservatively set at $1,200 (30). As shown in Table 4, the construction cost for an estimated 54,012 curb ramps is more than $64.8 million.

Table 4. City of Atlanta Curb Ramp Construction Cost

CURB RAMPS	
QUANTITY	54012
COST PER UNIT	$1,200
TOTAL COST	**$64,814,400**

3.1.4.2 Total Construction Cost of Curb Cuts

Curb Cuts are typically categorized into four types: Standard, Historic, Diversion, and Depression (14). The type of curb cut present in the neighborhood is often a function of when neighborhood was created. The construction of a curb cut costs around $140 per square yard (14). The length of a curb cut depends on the parcel class, but the depth is found to be about eight feet on average (31). Table 5 provides details on the construction cost of Curb Cuts.

Table 5. City of Atlanta Curb Cut Cost

CURB CUTS	
CURB CUT MILES	340
AVERAGE CURB CUT DEPTH (FEET)	8

Table 5. City of Atlanta Curb Cut Cost

CURB CUT AREA (SQUARE FEET)	**14373548**
CURB CUT AREA (SQUARE YARD)	1597061
CURB CUT COST PER SQUARE YARD	$140
TOTAL CURB CUT COST	**$223,588,524**

3.1.4.3 Total Construction Costs of Sidewalks

Sidewalks are assumed to be five feet wide in compliance with City of Atlanta requirements, total sidewalk area is estimated to be 74.0 million square feet (or 2804 miles) which is nearly two percent of the total area encompassed by the City of Atlanta. Sidewalks are typically four inches thick, and at a construction cost of $60 per square yard (30), the total estimated cost of construction of Atlanta sidewalks is $493.5 million as presented in Table 6.

Table 6. City of Atlanta Sidewalk Cost

SIDEWALKS	
SIDEWALK MILES	2804
SIDEWALK AREA (SQUARE FEET)	74035918
SIDEWALK AREA (SQUARE YARD)	8226213
SIDEWALK COST PER YARD	$60
TOTAL SIDEWALK COST	**$493,572,787**

3.1.4.4 Total Scenario Costs

The total cost of construction of sidewalk infrastructure for Scenario 1 (with curb cuts) is $781,975,711. While for the Scenario 2 (without curb cuts) total construction cost for sidewalk infrastructure is $558,387,187, which excludes the curb cut costs.

3.1.5 Life-cycle Construction Costs of Sidewalks, Ramps, and Curb Cuts

For a standard sidewalk sections, the expected life depends on quality of construction, the external environment (presence of trees, soil structure, etc.), and any non-pedestrian use that damages the sidewalks (10). Average sidewalk sections should readily last for 40 years, after which the sidewalk infrastructure typically needs to be replaced. It is assumed that the cost of replacement of the infrastructure will remain the same as the initial construction cost (a discount rate is employed to address the value of time). To calculate the Net Present Value for replacement of sidewalk infrastructure, a discount rate of 3.5% is employed (32).

To achieve a life cycle of 40 years, it will also be necessary to handle un-anticipated maintenance and repair of sidewalks that are affected by the vehicles driven or parked on sidewalk, utility works, and tree encroachment (that is, repairs that are above and beyond the normal pedestrian and weather wear and tear).

3.2 Ongoing Maintenance Costs

A variety of factors may contribute to the deterioration of sidewalks. The most common factor affecting sidewalk condition is the proximity of trees to the sidewalk sections. Tree roots extends underneath the sidewalk pavements and as the tree grows lifting or cracking of pavements may occur (33). Construction in proximity to the sidewalk

may disturb the sidewalk foundation, resulting in settlement of sidewalk sections. Such settlement may give rise to cracking of potholes along the sidewalk sections. Table 7 shows the common sidewalk and curb ramp ADA issues that can create a potential hazard for pedestrians (14).

Table 7. Common Sidewalk and Curb Ramp ADA Issues (14)

Issue	Description	Example Image
Uneven Sidewalk Surface	Typically refers to sidewalk cracking or pavement uplift. Often caused by adventitious vegetation growth, weathering, heavy equipment damage, or improper installation	
Sidewalk Pothole	A depression in the sidewalk surface often caused by weathering, or damage from heavy equipment	

Table 7. Common Sidewalk and Curb Ramp ADA Issues

Curb Ramp Absent	A designated pedestrian crossing where a curb ramp is missing which prevents some pedestrians with restricted mobility from crossing at these locations	
Curb Ramp with Steep Cross Slope	Steep slopes and cross-slopes can cause wheeled mobility devices to tip over, result from improper installation, and often occur where curb ramps are installed on a steeply-sloped road (not brought to level at the crossing)	
Curb Ramp with Missing Detectable Warning Surface (DWS)	A missing DWS can be a hazard for blind pedestrians (especially when inconsistently installed) and often occur at locations where curb ramps were installed before detectable warning surfaces were required	

Table 7. Common Sidewalk and Curb Ramp ADA Issues

Curb Ramp with Steep Running and/or Flare Slopes	A curb ramp with running slopes or flare slopes that exceed ADAAG standards can hinder or prevent pedestrians with mobility restrictions, especially those with wheeled mobility devices, from using the ramp	

3.2.1 Four Corridor Evaluation for Sidewalk Defects

The Georgia Tech Sidewalk Lab inspected four major corridors in city of Atlanta (Figure 2) between 2017 and 2018 (31,56-58). Curb ramp, curb cut, and sidewalks conditions were evaluated using standard ADA criteria. The details of the corridors are as follows:

- Monroe Drive – Armour Drive to Decatur Street
- Decatur Street – Boulevard to East Lake MARTA station
- Campbellton Road – Greenbriar Mall to Oakland City MARTA
- North Avenue – Marietta Street to Chandler Park Drive

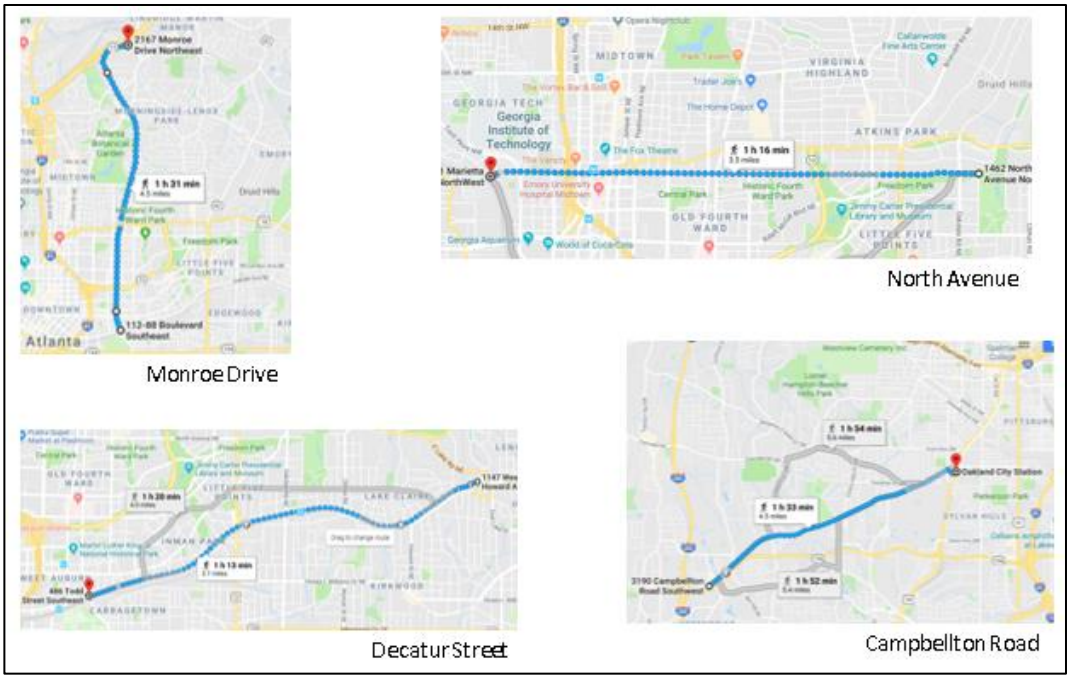

Figure 2. City of Atlanta Corridors

Maintenance cost for these corridors are divided into two parts: repair costs and replacement costs. Repair costs include damage to infrastructure while replacement costs are the result of ADA design guidelines violation. For the purpose of this thesis, it is assumed that all initial sidewalk infrastructure construction will comply with ADA standards; hence, the replacement costs associated with improper design will not be included in the calculation of un-anticipated maintenance costs.

The four corridors consisted of 33.1 miles of sidewalks, along with their respective ramps and curb cuts. Of the 615 ramps inspected, only 14 (2.3%) were found ADA compliant while the other 601 (97.7%) were ADA non-compliant. Of the 601 problem ramps, 127 (21%) required repair. The average repair cost per ramp was estimated to be $687. Of the 863 curb cuts inspected on these corridors, 157 (18%) were identified as ADA compliant while the remaining 706 (82%) were ADA non-compliant. Of the 706

problem curb cuts, 109 (13%) required repair work, at an average cost of $1,196 per curb cut. The sidewalk defects resulting from the field inspections were classified into specific categories for ADA violations (pothole, uneven surface, obstruction, debris, and inadequate width). A total of 1,904 sidewalk defects were identified on these four corridors as shown in Table 8, out of which more than 70% were classified as uneven surface defects. For each sidewalk mile, 58 sidewalk defects were identified, with an estimated average repair cost of $242 per defect.

Table 8. Summary of Four Corridors of City of Atlanta (31, 56-58)

	MONROE	DECATUR	CAMPBELLTON	NORTH AVE	TOTAL
SIDEWALK MILES	**9.7**	**7.4**	**9**	**7**	**33.1**
RAMPS	**244**	**109**	**109**	**153**	**615**
ADA NON-COMPLIANT	237	109	107	148	601
ADA COMPLIANT	7	0	2	5	14
CURB CUTS	**339**	**108**	**234**	**182**	**863**
ADA NON-COMPLAINT	295	87	167	157	706
ADA COMPLIANT	44	21	67	25	157
DEFECTS	**805**	**339**	**466**	**294**	**1904**
POTHOLE	89	33	43	37	202
UNEVEN SURFACE	582	234	327	214	1357
OBSTRUCTION	4	30	16	12	62
DEBRIS	119	33	43	23	218
WIDTH	11	9	37	8	65

Table 9 shows the maintenance cost for the City of Atlanta using the findings from the four corridors.

Table 9. Additional Maintenance Costs for City of Atlanta

PERCENTAGE OF RAMP REQUIRING REPAIR		**21%**
REPAIR COST PER RAMP DEFECT	$	686
TOTAL RAMPS IN ATLANTA		54,012
RAMP REPAIR COST FOR ATLANTA	**$**	**7,656,706**
PERCENTAGE OF CURB CUTS REQUIRING REPAIR		**13%**
REPAIR COST PER CURB CUT DEFECT	$	1,196
TOTAL CURB CUTS IN ATLANTA		101,389
CURB CUT REPAIR COST FOR ATLANTA	**$**	**15,321,988**
SIDEWALK SURFACE DEFECTS PER MILE REQUIRING REPAIR		57
COST PER SIDEWALK SURFACE DEFECT	$	242
SIDEWALK MILES IN ATLANTA		2804
SIDEWALK DEFECT REPAIRS FOR ATLANTA	**$**	**39,129,300**

3.3 Total Cost of Ownership

The total cost of ownership includes the initial construction cost, maintenance cost, and cost of removing the entire sidewalk system each time it reaches the end of its 40-year lifespan. Ideally, the system would extend to perpetuity as shown in Figure 3.

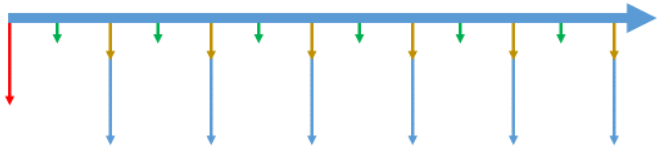

Figure 3. Allocation of Costs Over Time

Figure 3 shows the costs associated with construction cost, maintenance, and demolition over the time, where red arrow represents the initial cost which occurs at Year 0, green arrow represents the maintenance cost every 40 year starting with an offset of 20 years, yellow is the demolition cost needed at the end of every 40 years, and blue is the major reconstruction cost which takes place along with the demolition at every 40 years.

For the purpose of the analysis, 80-year life cycle period is assumed. Initial construction occurs in Year 0, demolition and replacement occurs in Year 40, major maintenance in Year 20 and 60 and another demolition in Year 80 followed by the next cycle. It is important to note that actual maintenance cost is spread out over the entire life cycle period but for the calculation purpose the maintenance assumed to take place on Year 20 and 60.

Engineering Economics allow to convert all the all above mentioned cost into its Net Present Value (NPV). The total NPV costs for Scenario 1 is $1.18 billion, which is

equivalent to $423,109 per sidewalk mile, while that for Scenario 2 is $869.4 million, which is equivalent to $310,059 per sidewalk mile.

NPV is converted to Equivalent Annual Cost (EAC) to distribute the pedestrian life-cycle infrastructure costs to an annual equivalent. EAC is necessary to create a sustainable annual budget cycle. EAC equation is based on NPV, discount rate and asset life cycle. Hence, at a discount rate of 3.5% and for a life cycle of 80 years, the EAC for the pedestrian infrastructure is $55.5 million and $40.7 million for Scenarios 1 and 2 respectively as shown in Table 10.

Table 10. Total Recurring 80-Year Cost of Ownership for Scenario 1 and 2

	TOTAL NET PRESENT VALUE	EQUIVALENT ANNUAL COST
CURB RAMP	$ 86,004,631	$ 4,027,363
CURB CUT	$ 316,989,777	$ 14,843,770
SIDEWALK	$ 783,401,966	$ 36,684,585
TOTAL	**$ 1,186,396,374**	**$ 55,555,718**

CHAPTER 4. SOCIOECONOMIC ASPECTS OF SIDEWALKS

Infrastructure investments are distributed through political processes that may advantage some stakeholders and disadvantage others. Several potential mechanisms can be used to connect a community's socioeconomic characteristics with the investment in its public infrastructure. Many factors may influence the distribution of public infrastructure investment, including the political environment, the local, regional, and statewide commitment to equity, and the existence of law that require specific distributions of resources (35). There are potential mechanisms which may link a neighborhood's characteristics with its allocation of public infrastructure resources. For example, neighborhoods with higher than average income level or more education level may be able to convince the local government to place certain amenities in their neighborhood (35). Due to residential segregation, the geographic patterns of pedestrian infrastructure may be inequitable in terms of race and socioeconomic composition of the neighborhood (36).

Low income and minority group travel by walking at higher rates than other groups (37), but the quality of pedestrian infrastructure in such communities may be relatively poor (38). There is limited research on equity to pedestrian infrastructure by race/ethnicity and income, but some studies have provided evidence on the association of sidewalks in the community with race/ethnicity and socioeconomic status (38). There is growing evidence to suggest that the community environment in which people live can influence walking. For example, people walk more in communities where sidewalks are in compliance with ADA standards with few obstructions (29). Not all neighborhoods provide equal opportunities to walk, either for transportation or recreation. Low-income

and racial/ethnic minority communities struggle to access good condition pedestrian infrastructure that supports physical activity (39). Apart from low-income and ethnic minority group, special attention may be required to ensure equitable allocation of resource to neighborhoods with elderly adults, children, people with no vehicle access, etc. (40).

Low-income neighborhoods have fewer sidewalks, traffic calming devices, and marked crosswalks than high income neighborhoods (41). People living in low-income neighborhood are less likely to be provided with sidewalks and street/sidewalk lighting (41). It is important to not neglect such communities, which may be in dire need for the installation of new pedestrian infrastructure or repair of existing infrastructure.

This chapter tries to quantify an association between income/ethnicity/race and sidewalk miles across Atlanta neighborhoods. The purpose of this association is to help cities better understand the distribution of pedestrian infrastructure by ethnicity and income, which could be used by actors at various levels of government to potentially address any sidewalk infrastructure placement or condition disparities.

4.1 A Glance into Atlanta's Neighborhoods

The City of Atlanta is divided into 244 neighborhoods (42). Demographic data licensed from Epsilon are used to assess household income, as well as the ethnic groups of more than 2 million Atlanta households. The basic information contained in Epsilon data is spatially joined to the Atlanta neighborhoods using ArcMap. The income and ethnic groups for 176,980 Atlanta households were allocated to these neighborhoods.

4.1.1 Neighborhoods and Sidewalks

To calculate sidewalk length for each neighborhood, a subset of the complete sidewalk network was extracted for each neighborhood in ArcMap using geo-processing tools. A similar process was used to obtain number of ramps in each neighborhood. Figures 4 and 5 shows histogram for number of neighborhoods by ramps and sidewalk miles respectively.

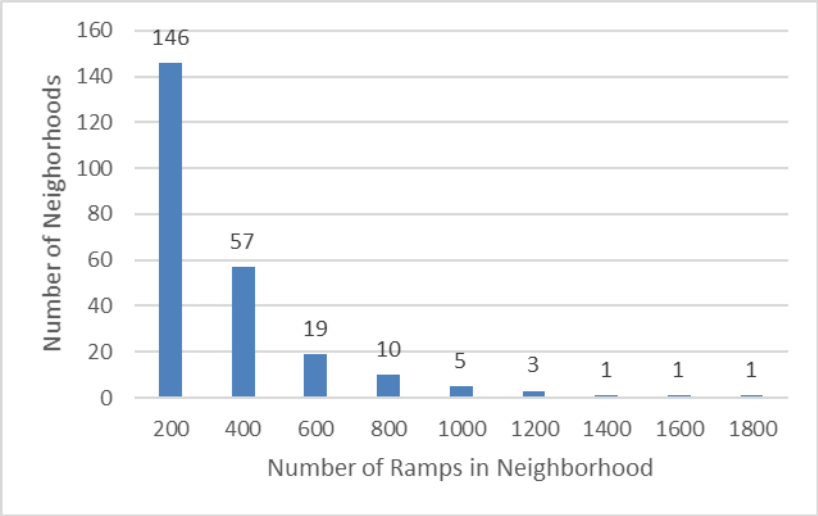

Figure 4. Number of Ramps in Neighborhoods

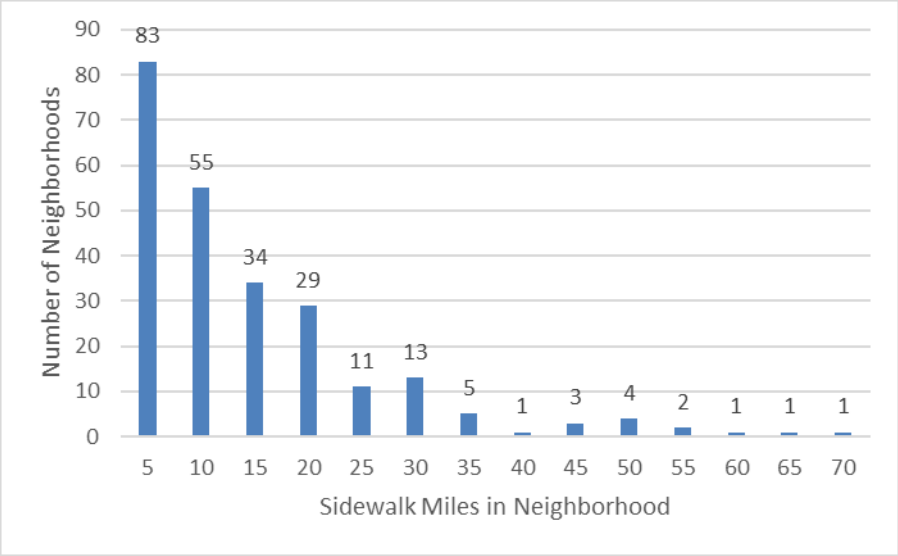

Figure 5. Sidewalk Miles in Neighborhood

Figure 6 shows the relationship between sidewalk miles and number of households in each neighborhood, illustrating a clear trend between total sidewalk length and number of households. Basic correlation analysis shows the correlation coefficient of 0.72. The outlier in the graph represents Midtown, where number of households is around 13,000 and is much higher than any other neighborhood in Atlanta.

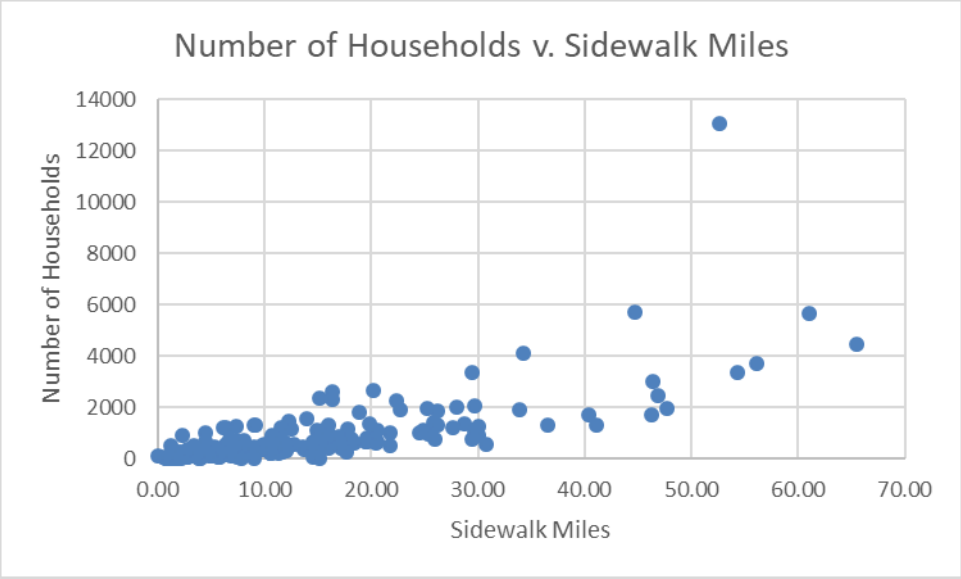

Figure 6. Sidewalk Miles v. Number of Household for each Neighborhood

4.1.2 Income

The income index data provided by Epsilon compares the household's income to the average income for the county in which the household is located. Hence, households with income equal to the county-average income will have an index of 100. An index of 125 indicates that the household income is 25% above the county's average income. Figure 7 shows the frequency number of households adjoining the sidewalks as per their income index. Figure 8 represents sidewalk length (feet) in each neighborhood along with their average income index. The average income index is relatively low in southern and western part of Atlanta. Miles of sidewalk per acre decreases as distance from the city center increases. Details on each neighborhood and associated income index can be found in Appendix A.

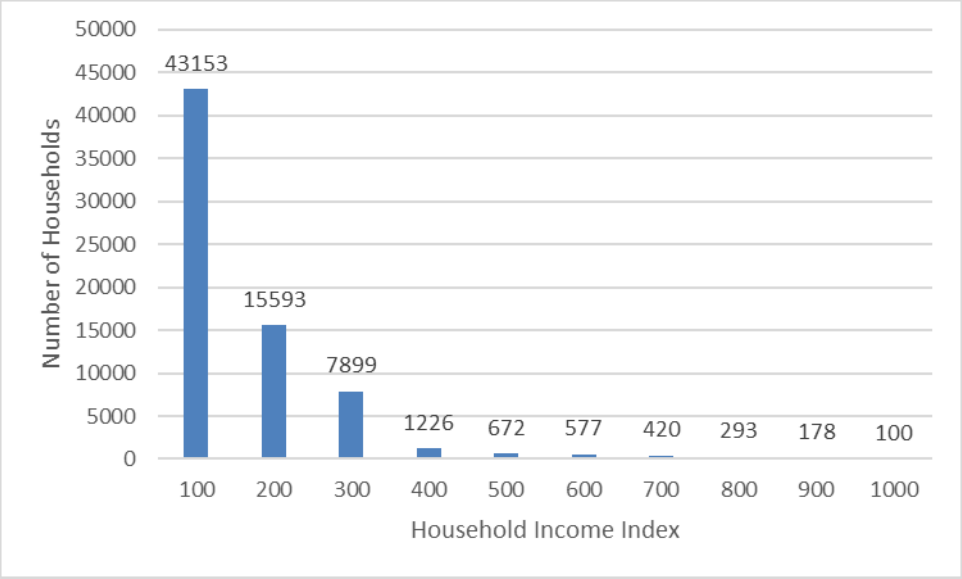

Figure 7. Number of Household and Household Income Index

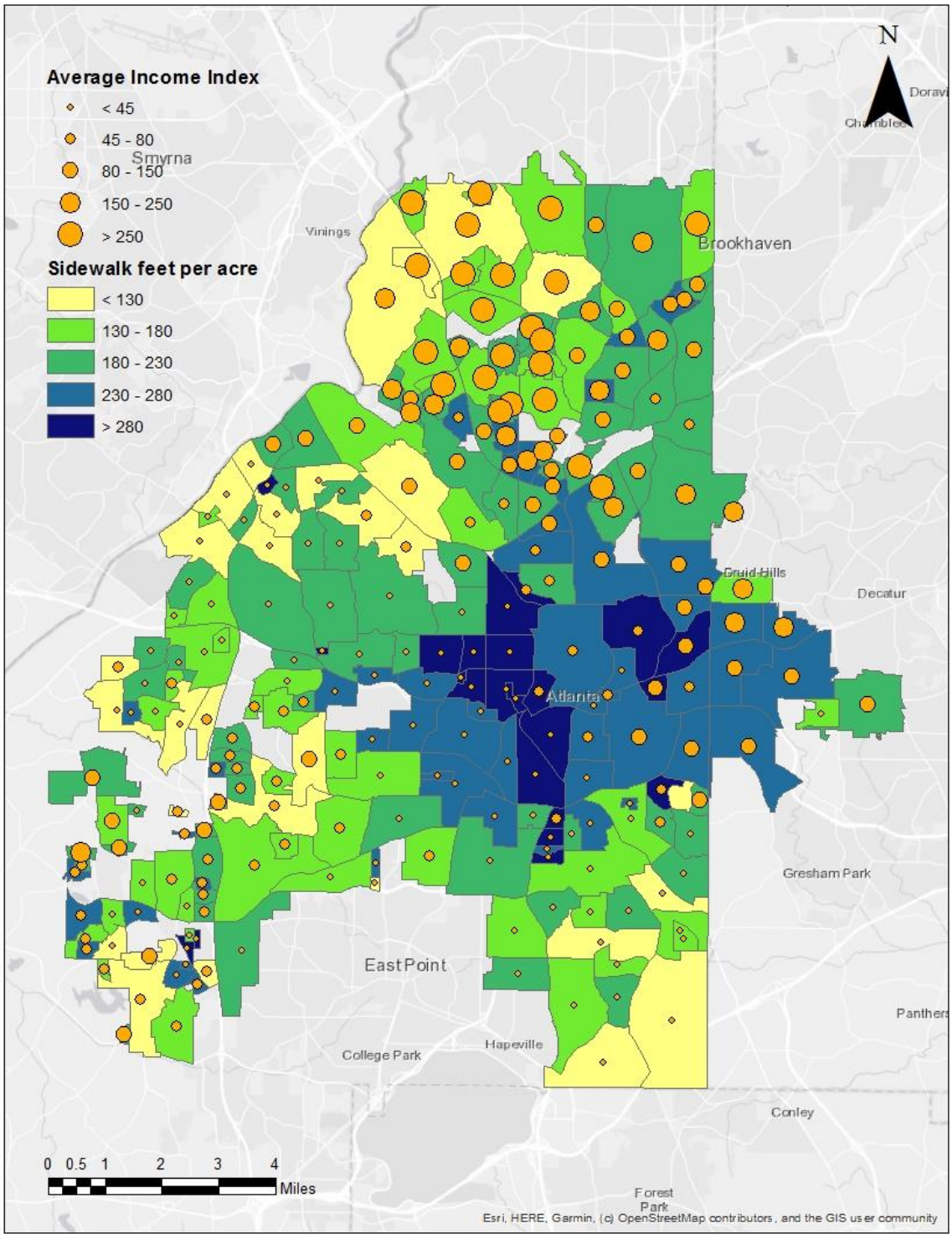

Figure 8. Average Income Index and Sidewalk Length (feet) per Acre for Atlanta Neighborhoods

4.1.3 Ethnicity

The ethnic groups provided in the Epsilon data set are shown in Table 11 along with household percentage in city of Atlanta.

Table 11. Percentage Households for Different Ethnicity Groups

ETHNIC GROUP CODE	ETHNICITY	PERCENTAGE HOUSEHOLDS IN ATLANTA
A	African American	46.9%
B	Far Eastern	1.92%
C	Southeast Asia	1.11%
D	Central and Southwest Asia	0.07%
E	Mediterranean	2.31%
F	Native American	0.05%
G	Scandinavian	1.27%
H	Polynesian	0.14%
I	Middle Eastern	1.13%
J	Jewish	2.86%
K	Western European	37.11%
L	Eastern European	1.78%
O	Other Groups	0%
Y	Hispanic	3.31%
Z	Uncoded	0.01%

In Figures 8 and 9, it is evident that the percentage African American households in Atlanta neighborhood is inversely proportional to the average income index. B provides a neighborhood-by-neighborhood summary of the income and ethnicity data for all the neighborhoods of Atlanta.

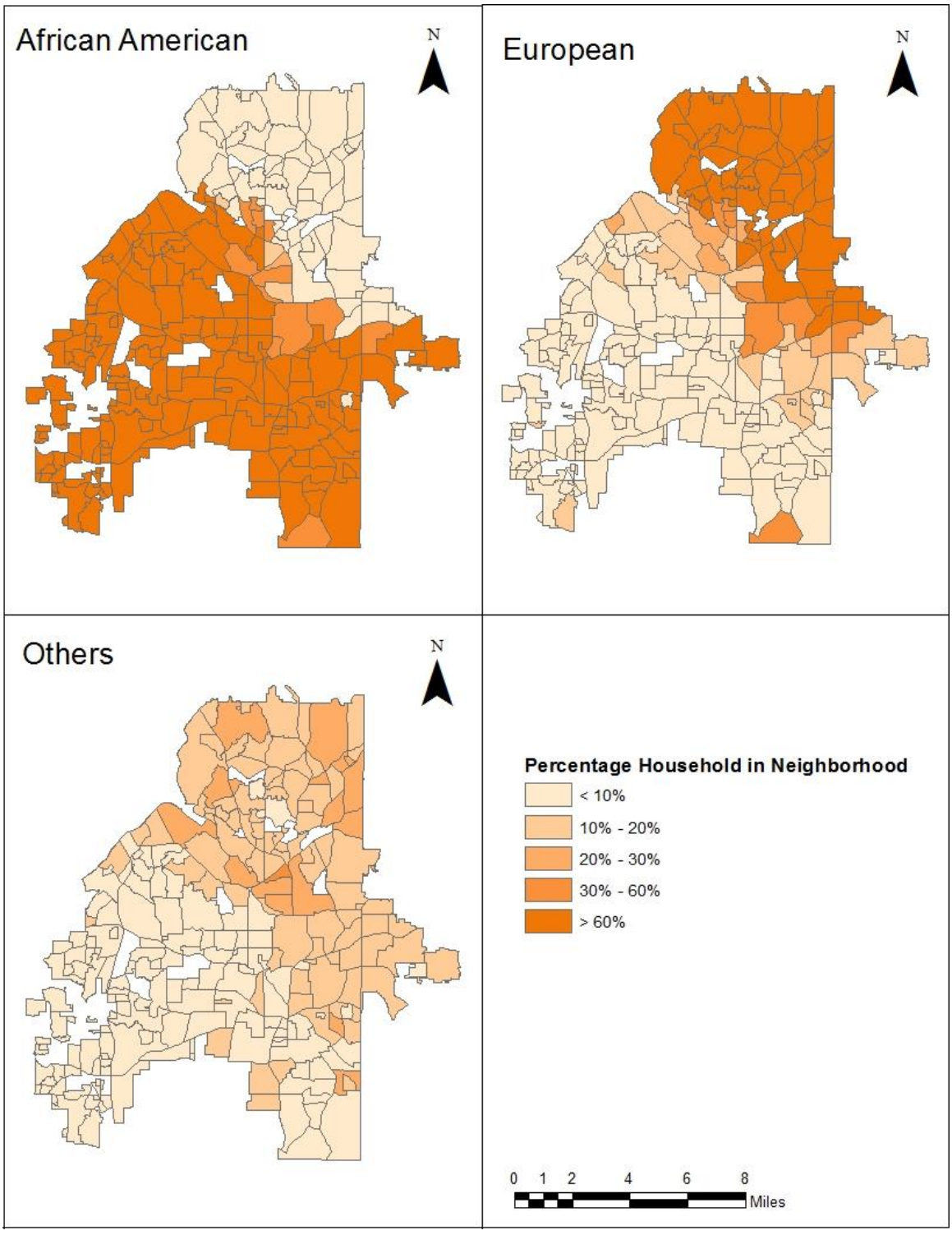

Figure 9. Percentage of Neighborhood Households by Ethnicity

CHAPTER 5. SUSTAINABLE SIDEWALK MANAGEMENT

According to Pedestrians Educating Drivers on Safety (PEDS), an advocacy organization dedicated to making streets and communities in Georgia safe and accessible to all pedestrians, "Atlanta's sidewalk maintenance policy is as busted as its sidewalks (22)". Atlanta's current sidewalk policy makes abutting property owners responsible for maintenance of sidewalks (43). Atlanta's annual budget allocates less than $500,000 to routine sidewalk maintenance while the Public Works estimated an annual maintenance cost of $20 million *(22).* Wheelchair users sued Atlanta in 2018 over the terrible condition of sidewalks, the lawsuit says Atlanta is responsible for a "systematic failure to maintain sidewalks that are equally accessible to person with mobility impairments". In a 2009 settlement with the U.S. Department of Justice, the City of Atlanta agreed to establish a system for disabled people to report ADA non-compliant sidewalks, but the city hadn't done anything to address this matter *(44).*

Mayor Keisha Lance Bottoms established a city's first ever dedicated Department of Transportation (DOT) on June 18, 2019. The DOT is aimed to improve safety and accessibility (45). This new agency plans to manage a range of transportation issues including sidewalk maintenance to make streets more accessible to people of every age and ability. The agency will combine the work of multiple City departments like Department of Public Works and Department of City Planning's Office of Mobility, integrated with infrastructure investment program of Renew Atlanta Bond / Transportation Special Purpose Local Option Sales Tax (TSPLOST) (45).

With the establishment of the new agency, Atlanta has a chance to adopt a sustainable sidewalk maintenance program for the city. This chapter discusses sustainable sidewalk maintenance program in different cities around the country to see how other cities are managing their sidewalk maintenance. Based on other cities' maintenance program, the chapter provides a series of recommendations, designed to suit Atlanta's needs for equitable sidewalk maintenance.

5.1 Los Angeles, CA

Los Angeles has approximately 11,000 miles of sidewalks, most of which require repair and replacement (46). The lack of maintenance of these sidewalks forced a group of concerned residents to sue the City of Los Angeles. In 2016, the city reached a settlement that requires the city's commitment of $1.4 billion over the next 30 years to fix the sidewalks throughout the City of Los Angeles (46).

In response to the settlement, the city launched "Safe Sidewalks LA," which became the largest sidewalk repair program in the nation. The program aims to repair and upgrade sidewalks as needed to comply with the ADA. The city established three programs that allow people to request repairs. The Access Request Program is the priority repair program where requests related physical barriers such as broken sidewalks, missing/broken curb ramps or other similar repair requests are addressed. The Rebate program allows residential and commercial property owners to receive a rebate up to $10,000 for privately funded sidewalk repair (46). The Report a Sidewalk Repair program is for the rest of the problems related to sidewalks. The timeline for these repairs depends on the funding availability.

Once a sidewalk is repaired and designated as ADA-compliant, the city issues a sidewalk warranty certificate for 20 years for residential properties and five years for commercial properties. If something goes wrong during the warranty period, the city will fix the sidewalks one more time, but after that owner will be responsible for maintaining the repairs. This program is referred to as "fix and release (46)".

The city of Los Angeles tries to protect trees while repairing sidewalks. The goal is to minimize the tree removal. To ensure this, the sidewalk maintenance crew will prune tree roots and install root barriers to prevent future sidewalk heaving (which creates sidewalk section disjoints) caused by tree roots. If a tree must be removed, the city replaces it with at least two new trees to help sustain the urban canopy over the long term (46).

The city of Los Angeles has also established a pilot project which tries to use alternative materials for sidewalk repairs to identify the best materials that will help sidewalks last longer. Sidewalks constructed of alternative materials are being installed at city facilities for performance monitoring and assessment (46).

5.2 Berkeley, CA

City trees are a grave concern to any sidewalk maintenance program. Tree roots may grow under the sidewalks resulting in sidewalk heaving (47). In such repair cases, damaged portion of sidewalk concrete is removed, tree roots are pruned, and new concrete is poured. Under the 50/50 cost sharing, the abutting property owner pays 50% of the sidewalk replacement cost and the rest 50% is covered by the city, but there is no charge to property owners for root pruning (48).

To address residents' concern over payment for ongoing sidewalk maintenance caused by the trees, the city has proposed to pay for sidewalk repair for damage caused by the same city tree within 10 years of the first repair. If a third repair is needed within 10 years of completion of initial 50/50 cost sharing replacement, the city will again pay for the full expense, and the property owner will have an option of removing and substituting the tree for a less-invasive city-approved tree at the property owner's expense (48).

5.3 San Diego, CA

The City of San Diego performed a comprehensive sidewalk assessment of all 4,580 miles of sidewalks (49), finding more than 85,000 damaged sidewalk locations and 21,465 noncompliant curb ramps. Similar to City of Berkeley, the City of San Diego offers a 50/50 cost share program. The average repair cost to homeowner is estimated to be around $3,000, which is not affordable for many homeowners, especially for low-income households. As a result, very few residents pay to fix city sidewalks and the backlog continues to grow. Given the existing policy, the city remains liable for any injuries caused by poor sidewalk condition. Since 2013, the City of San Diego has paid at least $7 million for litigation regarding poor sidewalk condition (49).

5.4 Iowa City, Iowa

Iowa City asserts that the maintenance of sidewalks is the responsibility of the adjoining property owner. For their inspection program, Iowa City is divided into ten geographical areas (Figure 10). Every year, one of these areas is systematically inspected to assess the sidewalk repair needs. The inspection program does not include any driveways or curb cuts (50).

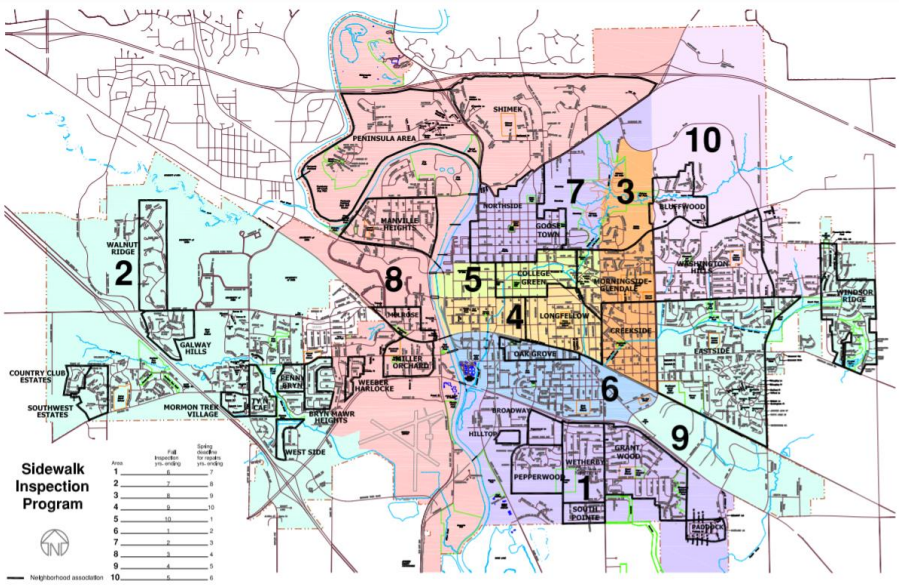

Figure 10. Geographical area of Iowa City

After the inspection, property owners adjacent to any sidewalk that requires maintenance are provided a copy of the inspection report and notified of their responsibility to repair the sidewalk (Figure 11). Property owners must meet a May 15 or September 15 deadline for the repairs (50).

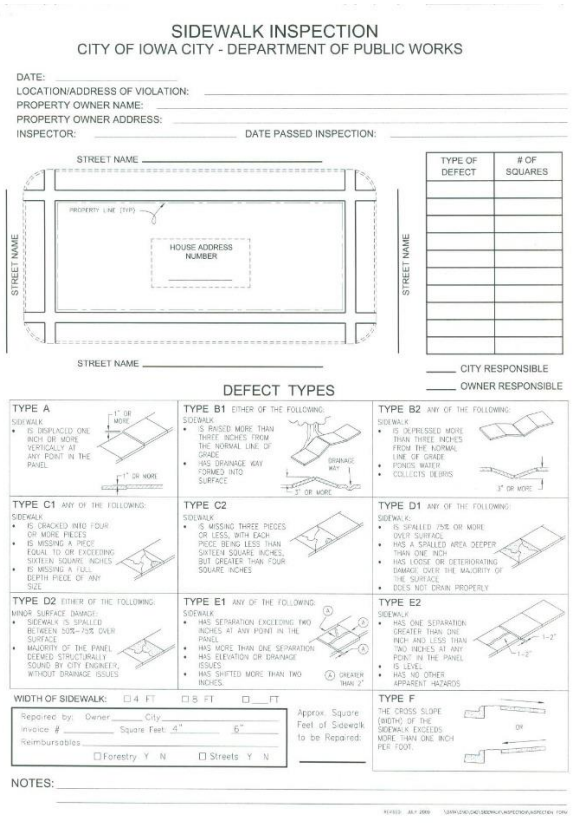

Figure 11. Iowa City Sidewalk Inspection Report Form

If the damage is caused by a city owned item (e.g., sewer manholes, utility pole, trees, etc.) the city takes the responsibility for the repair of the sidewalk. The city is also responsible for the maintenance of all the curb ramps across the public streets (50).

5.5 Sacramento, CA

Within the City of Sacramento, there are approximately 2,300 miles of sidewalks (51). Sacramento Code, section 12.32 requires that the maintenance and repair of the public sidewalks be the responsibility of the adjoining property owner (51).

If a defect is identified, the City of Sacramento sends the adjoining property owner a Sidewalk Repair Notice with an estimate of the cost for the repairs and options for making the repairs. If the property owner does not respond in 30 days, the city sends a second notice providing the property owner another 30 days. If 60-days have passed and the property owner has not completed the repair work, the City will repair the sidewalks by default and send the bill to the property owner. In case of tree roots causing damage to the sidewalk, irrespective of who owns the tree, it is still the property owner's responsibility to pay for sidewalk repair (51).

5.6 Recommendations

5.6.1 Citywide Sidewalk Inspection Program

The city should consider developing and executing a proactive 20-year sidewalk inspection program similar to that of Iowa City. This means that at least 5% of the city sidewalks would be inspected each year for ADA compliance. All the inspection should be digitized in a geographic information system (GIS) software. The City of Atlanta has already been divided into 244 neighborhoods. Hence, the City of Atlanta could inspect 12-13 neighborhoods each year. After a careful analysis of the neighborhood characteristics and corresponding sidewalk condition, a neighborhood inspection prioritization list should be prepared. Over the period of 20 years, all sidewalks in the city will have been inspected, and a new neighborhood priority list can be prepared (incorporating all the changes over the twenty-year period) and the cycle continues in perpetuity.

The City will have to develop or adopt a method to prioritize the sidewalk repairs. Many sidewalk prioritization methods have been developed over the years based on high

pedestrian activity, safety accessibility, and mobility for persons with disability. The City of Portland developed two indices to prioritize pedestrian projects, the Pedestrian Potential Index (PPI) and Pedestrian Deficiency Index (PDI) (52). Georgia Tech Sidewalk Lab has developed similar indices to prioritize pedestrian projects. In previous studies in Atlanta, a Sidewalk Priority Index (SPI) has been used to reflect the relative importance of the sidewalk to the pedestrian infrastructure system, weighted by its contribution toward mobility, accessibility, and safety, and the Sidewalk Repair Index (SRI) assigns a relative priority for repair based upon the need for repair coupled with the SPI (52, 59).

5.6.2 Funding Options

To establish funding options for the city of Atlanta's sidewalk maintenance, the Net Present Value of both the scenarios, with and without curb cuts, is used from Chapter 3. The Equivalent Annual Cost for Scenario 1 (curb ramp, curb cut, and sidewalk) is $55.5 million, while that for Scenario 2 (curb ramps and sidewalks) is $40.7 million. The difference between both the case is the equivalent annual cost for curb cuts which amounts to $14.8 million. The analyses that follow focus only on the sidewalk costs and cost allocation for residential properties in the City of Atlanta. The sidewalk costs associated commercial and mixed use properties are not included, but could be analyzed in a similar manner.

If the residents of City of Atlanta wished to fund their sidewalks with an annual budget that allows for continuous construction, maintenance and replacement of sidewalk infrastructure, property tax might be a the most appropriate source of funding. To

understand the potential burden on property owners, the previously calculated EAC will be applied to the City of Atlanta's property tax formula.

For FY2018, the City of Atlanta raised about $191.8 million annually in property tax. The dollar value of one 'mill' in the millage rate fluctuates every year as per the City's budget measures (54). For FY18, the dollar value of one mill was recorded as $21.7 Million (54). For the purpose of this study, the millage rate formula was recreated to analyze the impact of raising property tax on residential households. The Homestead Act allows the exemption of $30,000 for residents under 65 and $40,000 for residents above 65 and meeting certain income criteria (55). For, example a household qualifying for the homestead act assessed at $100,000 would receive an exemption of $30,000 reducing the assessed value to $70,000, when multiplied by the FY18 millage rate of 8.84 (54) returns an annual property tax of $618.80. The following two analysis looks into the property tax increase caused by Scenarios 1 and 2.

5.6.2.1 Funding Option Analysis - Scenario 1

The equivalent annual costs for Scenario 1 include all costs associated with the sidewalk infrastructure (i.e., the equivalent annual costs for curb ramps, curb cuts and sidewalks). To calculate the increase in millage rate, the EAC of $55,555,718 was divided by the cost of one mill i.e. $21,700,000 resulting in the millage rate increase of 2.56. The average additional tax burden per residential property was $262.70. However, the burden is not distributed equally across properties; the burden is allocated in accordance with property tax assessment, with higher-value properties paying a larger share of the burden.

After applying the homestead exemption to the assessed value of each residential parcel and using the millage rate of 2.56, additional property tax burden was determined on residential property owners in the City of Atlanta. The households were then categorized based on their income and ethnicity. Figures 12 and 13 show the percentage of additional property tax burden on different income index and ethnic group respectively. Figure 14 shows the average additional property tax per residential property of different ethnicity. The average additional tax burden for different income index group is shown in Figure 15.

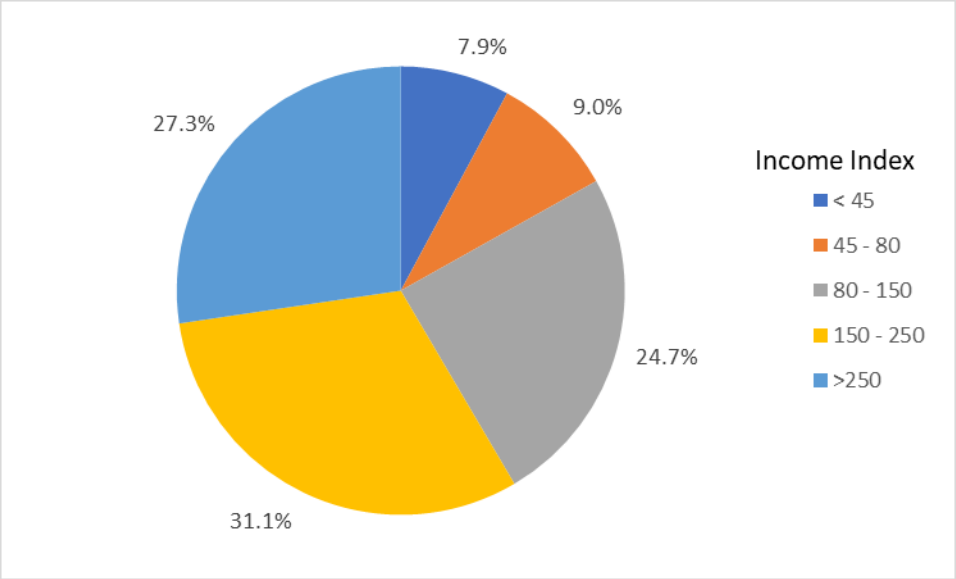

Figure 12. Percentage Additional Property Tax by Income Index

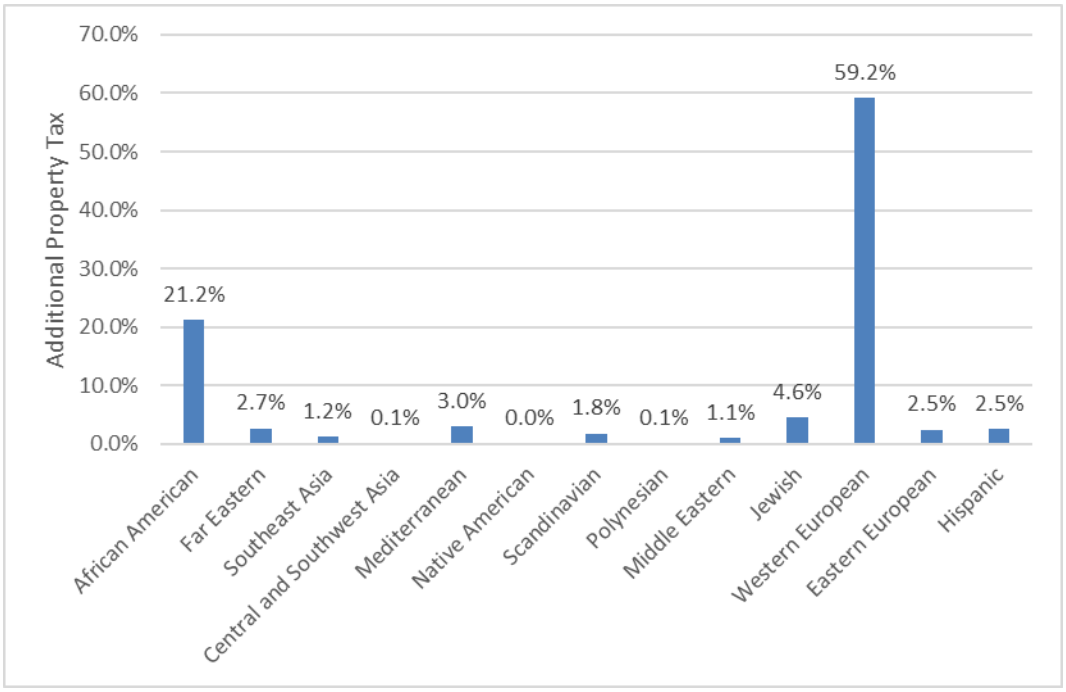

Figure 13. Percentage Additional Property Tax by Ethnicity

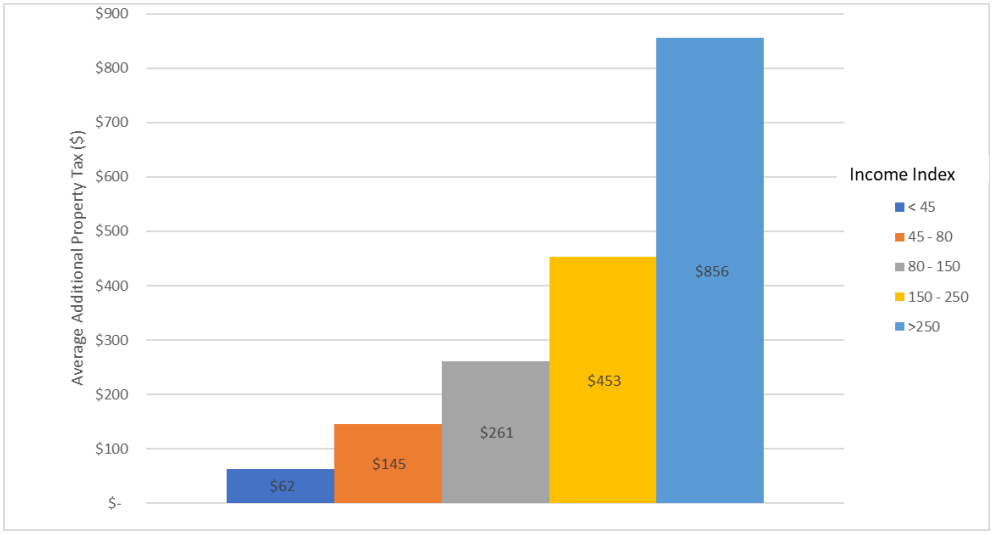

Figure 14. Average Additional Property Tax by Income Index – Scenario 1

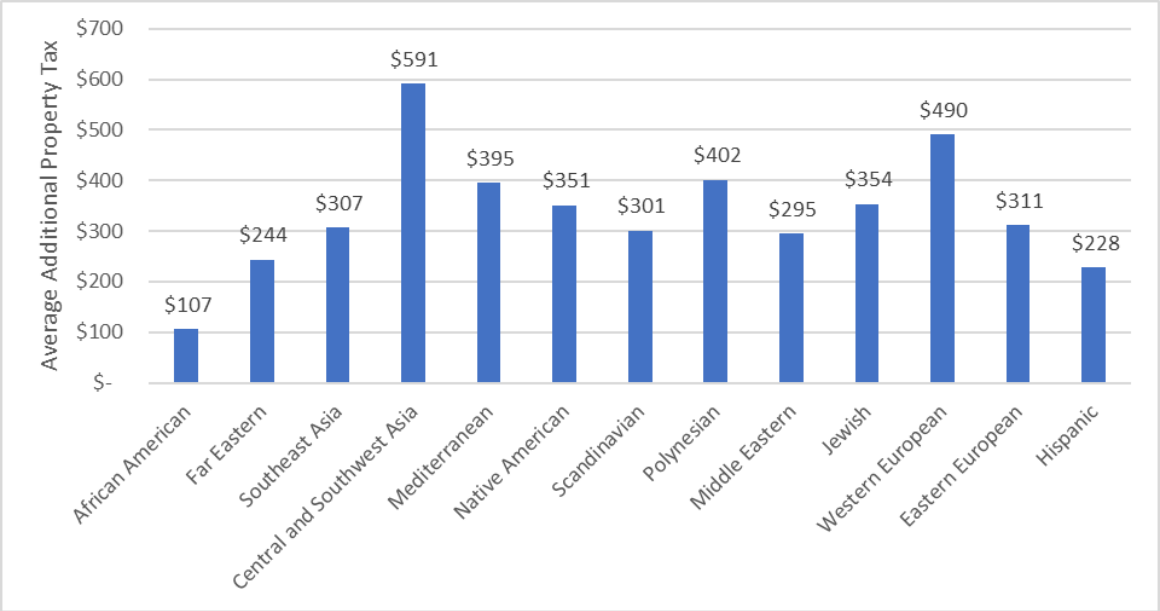

Figure 15. Average Additional Property Tax by Ethnicity – Scenario 1

5.6.2.2 Funding Option Analysis – Scenario 2

The fact that curb cut is not a primary public good is explicitly acknowledged in this Scenario. Hence, the curb cut costs are assumed to be completely covered by property owners, who benefit directly from the curb cuts. The costs of the remaining equivalent annual costs of $40,711,948 associated with sidewalks and curb ramps are then allocated via the traditional property tax assessment method. When the EAC is divided by the cost of one mill, as used previously, it results in increase of millage rate by 1.88. The average additional tax burden per residential property in this case is $362.37. The direct allocation of curb cut costs, plus the additional tax burden for different income index group is shown in Figure 16. The percentage additional property tax burden on different ethnicity and income group is similar to the previous case. Figure 17 shows the average additional property tax per residential property of different ethnicity.

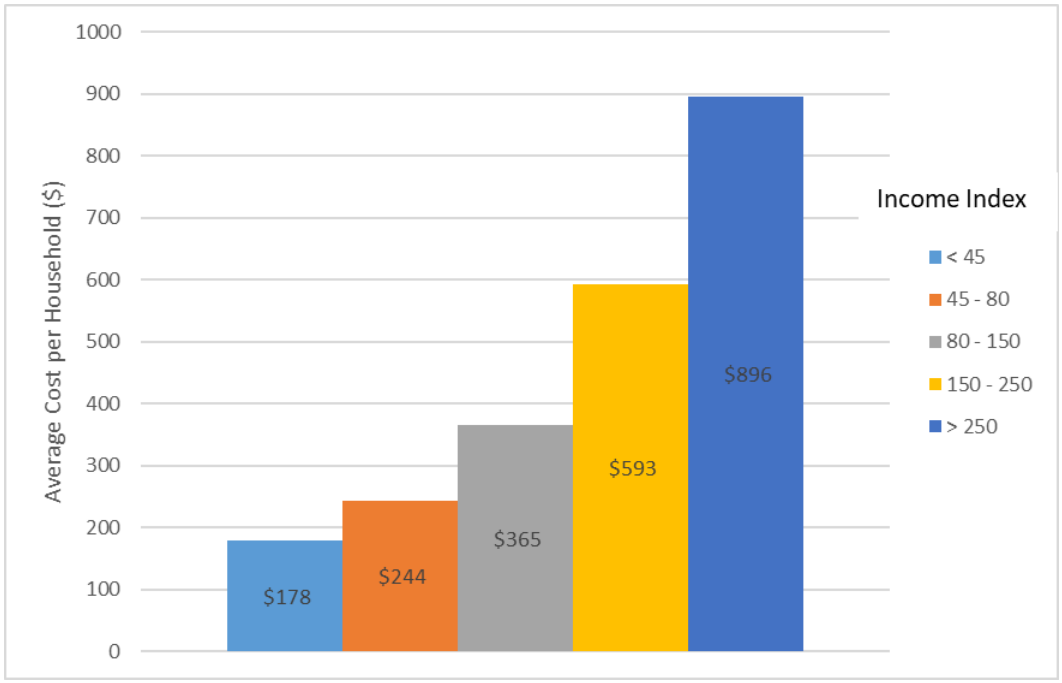

Figure 16. Average Additional Property Tax by Income Index – Scenario 2

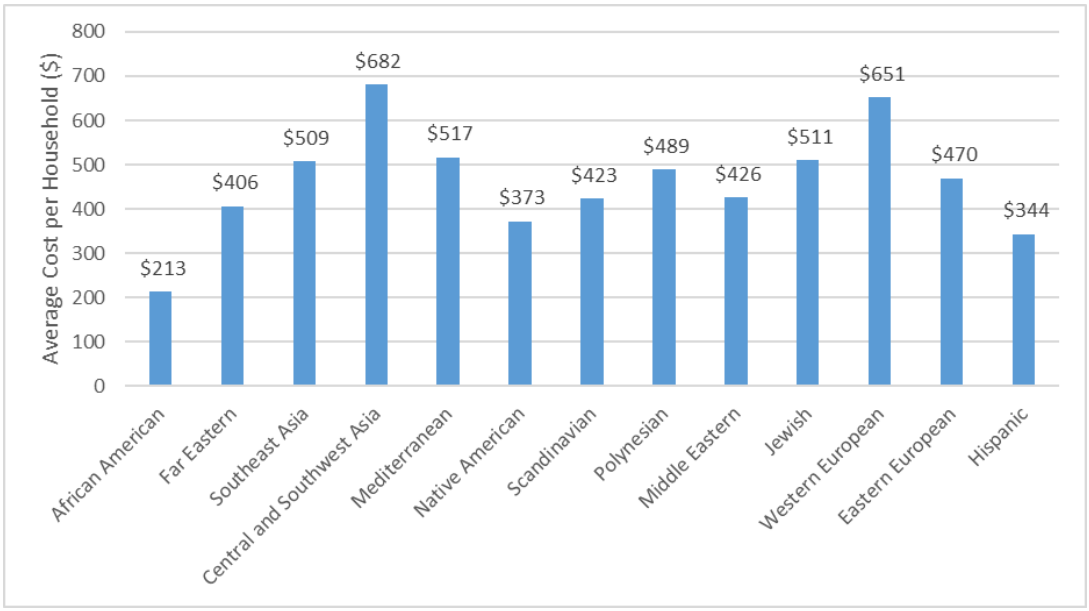

Figure 17. Average Additional Property Tax by Ethnicity – Scenario 2

5.6.2.3 Funding Option Analysis – Scenario 3

In Scenario 2, curb cut costs were allocated directly to property owners, rather than collected via property tax. Scenarios 3 and 4 will assume that private property owners continue to bear the costs of the curb cuts, the City will cover the costs of the curb ramps, and the remaining costs of the sidewalks will be split between the adjacent property owner and the City of Atlanta. Hence, a portion of the sidewalk costs will be assigned directly to the property owner, and a portion will be recovered via traditional property tax collection. It is important to note here that in Scenarios 3 and 4, adjacent property owners are bearing the cost of curb cuts as well as a part of sidewalk costs. For Scenario 3, the equivalent annual costs of the curb cuts ($14,843,770) are assigned directly to the private property owners, the equivalent annual costs of the curb ramps ($4,027,363) are assigned to the City and recovered via property taxes, 50% of the equivalent annual costs for sidewalks ($18,342,292) are assigned directly to the private property owners, and 50% of the equivalent annual costs for sidewalks ($18,342,292) are assigned to the City and recovered via property taxes.

The average cost per household of the property owners, who have sidewalk next to their property, is $476.72. Figures 18 and 19 provides information on the property owners with sidewalk next to their property based on their income index and ethnicity respectively. The average cost per household for different income index and ethnicity groups is shown in Figures 20 and 21 respectively.

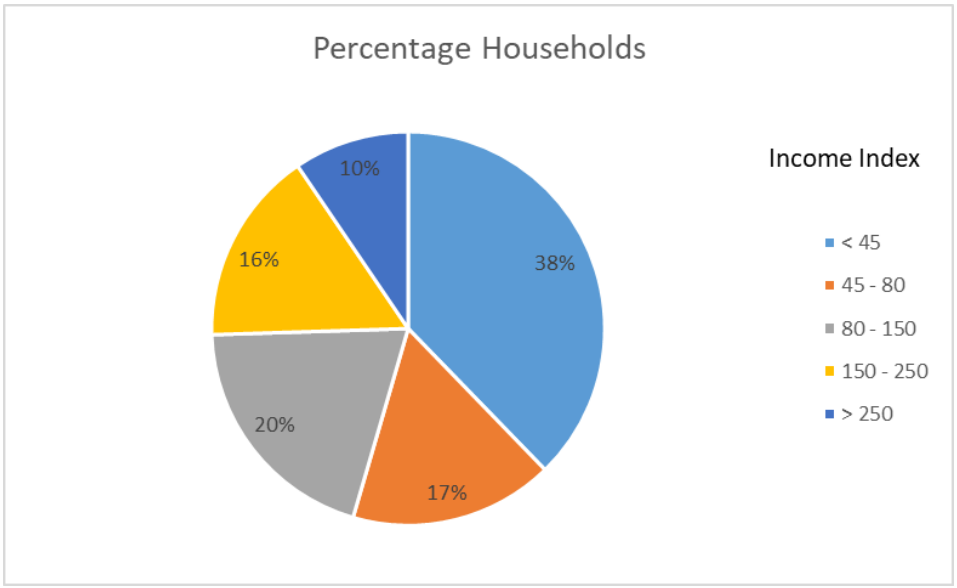

Figure 18. Percentage of Households with Adjacent Sidewalks by Income Index

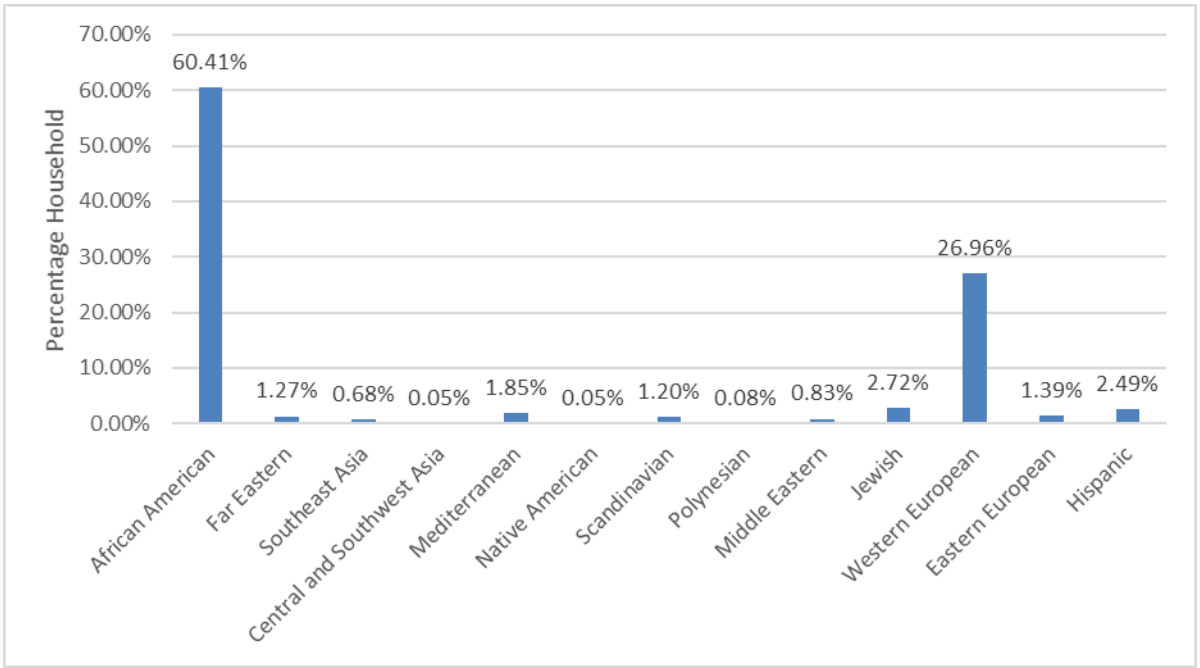

Figure 19. Percentage of Households with Adjacent Sidewalks by Ethnicity

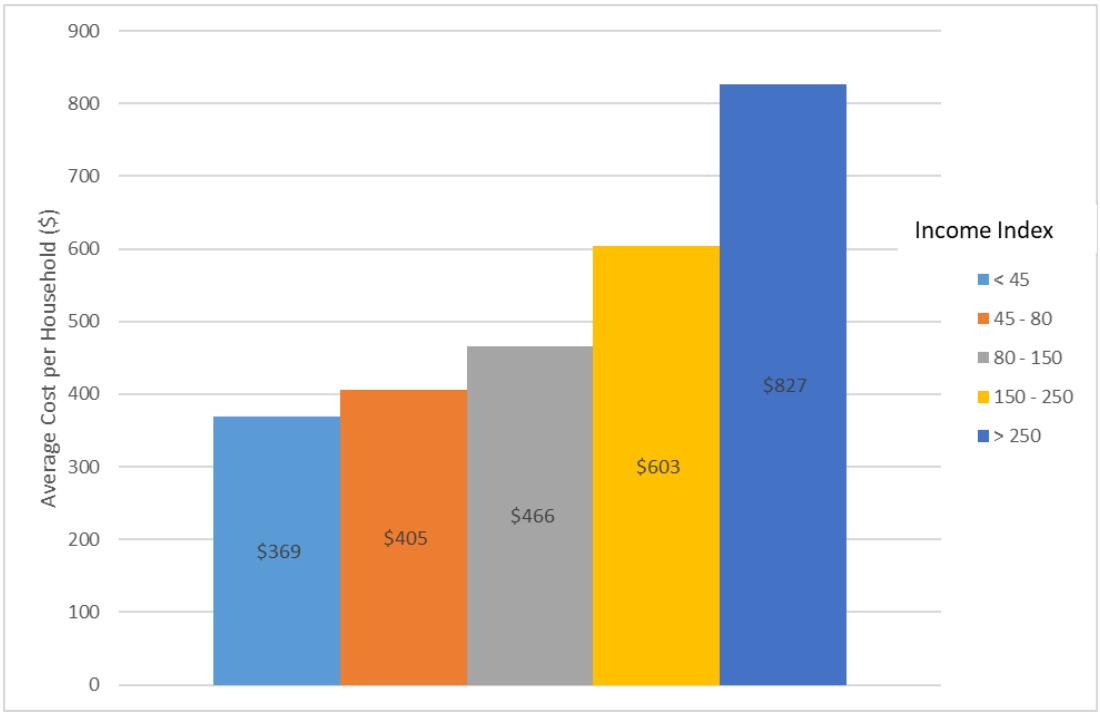

Figure 20. Average Cost per Household by Income Index – Scenario 3

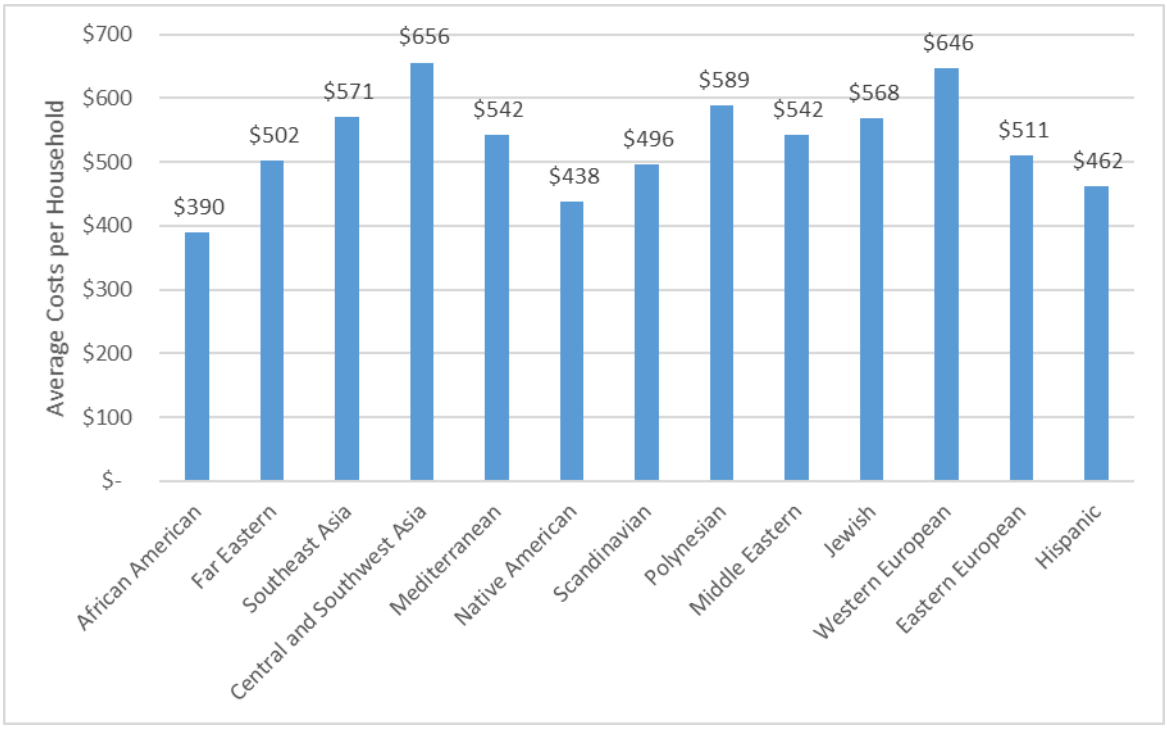

Figure 21. Average Cost per Household by Ethnicity – Scenario 3

5.6.2.4 Funding Option Analysis – Scenario 4

Scenario 4 replicates the analytical work of Scenario 3, but in this case the allocation of sidewalk costs are split 60/40 between the City of Atlanta and the adjacent property owners. For Scenario 4, the equivalent annual costs of the curb cuts ($14,843,770) are assigned directly to the private property owners, the equivalent annual costs of the curb ramps ($4,027,363) are assigned to the City and recovered via property taxes, 40% of the equivalent annual costs for sidewalks ($14,673,834) are assigned directly to the private property owners, and 60% of the equivalent annual costs for all sidewalks ($22,010,751) are assigned to the City and recovered via property taxes. The average cost per household with respect to ethnicity and income index is shown in Figures 22 and 23 respectively.

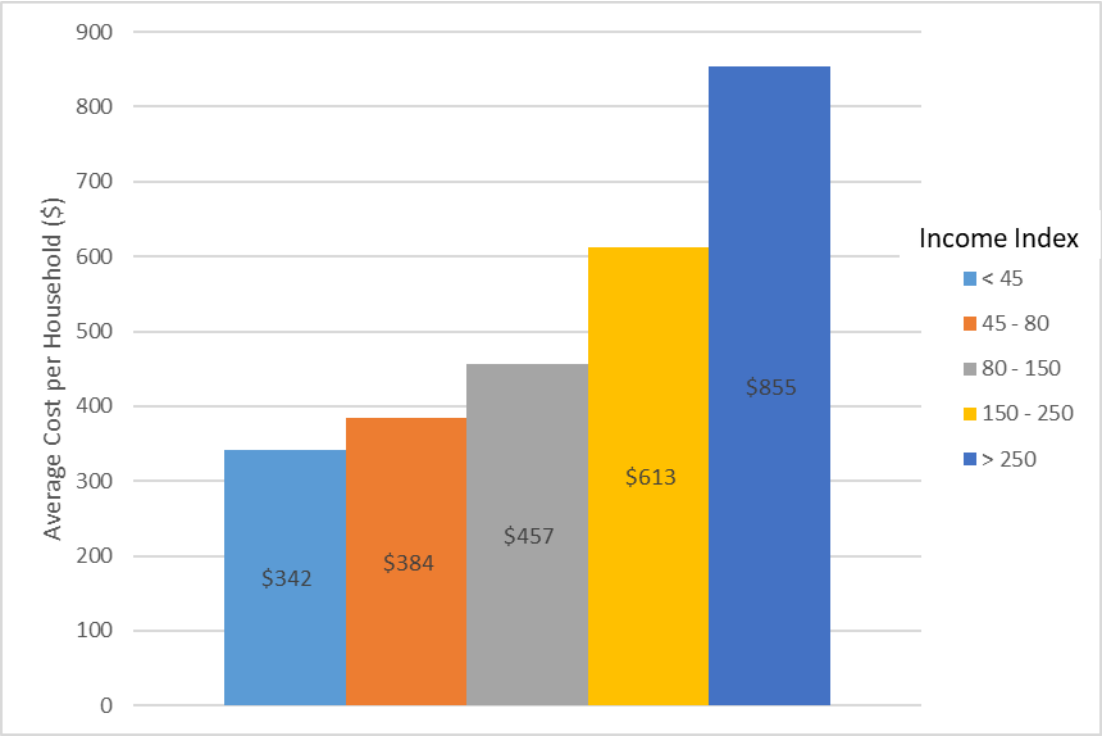

Figure 22. Average Cost per Household by Income Index – Scenario 4

Figure 23. Average Cost per Household by Ethnicity – Scenario 4

Table 12 summarize the cost allocation to the City and property owners.

Table 12. Cost Allocation Summary

	Percent Allocation to City					**Percent Allocation to Property Owner**			
	Scenario 1	Scenario 2	Scenario 3	Scenario 4		Scenario 1	Scenario 2	Scenario 3	Scenario 4
Ramp Construction (Initial)	100%	100%	100%	100%		0%	0%	0%	0%
Ramp Demolition (40-year cycle)	NA	NA	NA	NA		NA	NA	NA	NA

Table 12. Cost Allocation Summary

Ramp Reconstruction (40-year cycle)	**100%**	**100%**	**100%**	**100%**		**0%**	**0%**	**0%**	**0%**
Curb Cut Construction (Initial)	100%	0%	0%	0%		0%	100%	100%	100%
Curb Cut Demolition (40-year cycle)	100%	0%	0%	0%		0%	100%	100%	100%
Curb Cut Reconstruction (40-year cycle)	100%	0%	0%	0%		0%	100%	100%	100%
Sidewalk Construction (Initial)	100%	100%	50%	60%		0%	0%	50%	40%
Sidewalk Demolition (40-year cycle)	100%	100%	50%	60%		0%	0%	50%	40%
Sidewalk Reconstruction (40-year Cycle)	100%	100%	50%	60%		0%	0%	50%	40%
Sidewalk Repairs (40 year cycle, 20 year offset)	100%	100%	50%	60%		0%	0%	50%	40%

Figure 24 and Figure 25 compare the additional average cost per residential property for all the scenarios by income index and ethnicity.

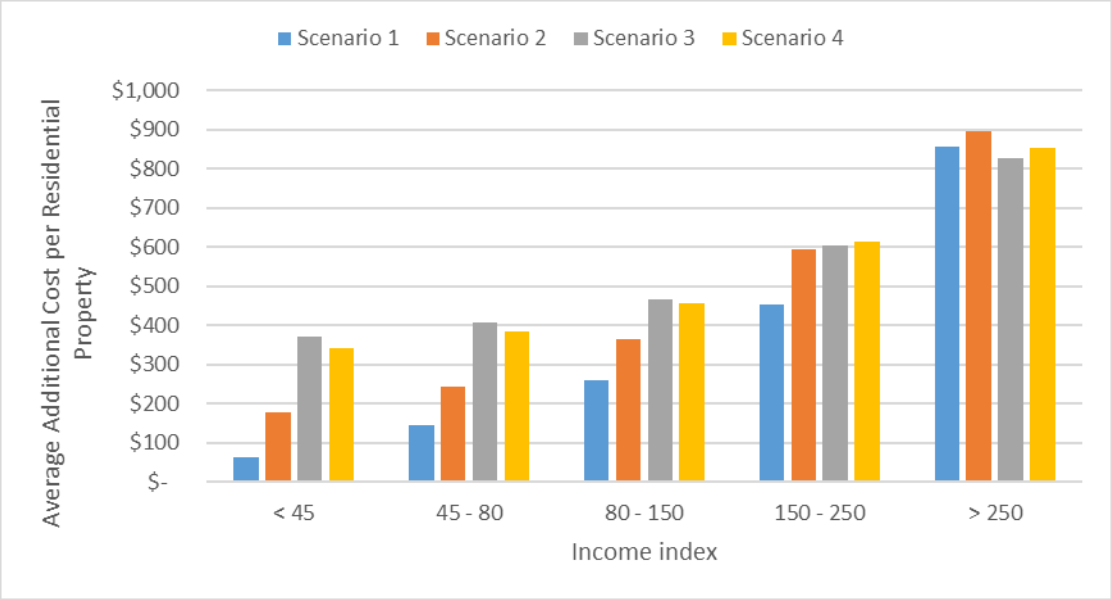

Figure 24. Average Additional Cost Comparison for all Scenarios by Income Index

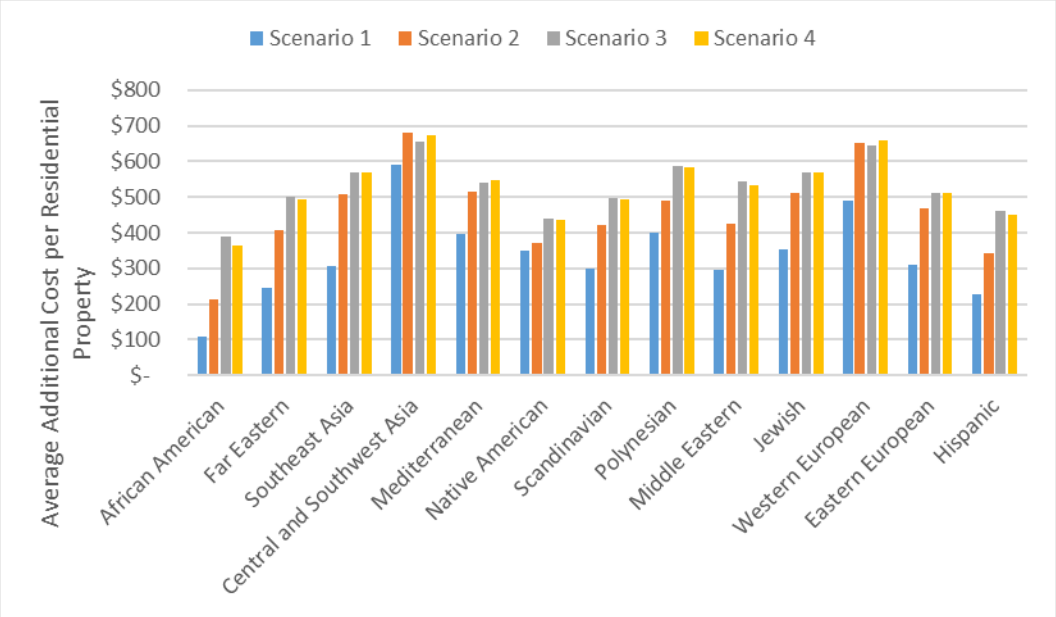

Figure 25. Average Additional Cost per Comparison for all Scenarios by Ethnicity

Even though the sidewalk costs allocated to residential property is greater in Scenario 3 than in Scenario 2, Figure 24 counterintuitively shows that the average additional cost for higher income property owners is lower in Scenario 3 than in Scenario 2. This is because Scenario 3 allocates half of the costs of sidewalks to adjacent property owners. In Atlanta,

many of the upper income neighborhoods simply do not have sidewalks; hence, only half of the total city sidewalk costs are now allocated to their properties.

CHAPTER 6. CONCLUSION AND FUTURE RESEARCH

Establishing a sustainable maintenance program requires the development of a sidewalk asset inventory, a systematic assessment of asset condition, and ongoing collection of funds necessary to maintain the state of good repair. Life-cycle costs were developed for the 2804 miles of sidewalk in the City of Atlanta using inventory and cost methods developed for this thesis. The model calculates the net present value (NPV) of construction, demolition and replacement for 80 year period, and un-anticipated maintenance costs that occur along the way. The NPV was then converted to equivalent annual cost (EAC) to help the City of Atlanta plan its annual budget. The equivalent annual cost for curb ramp, curb cut, and sidewalks was estimated to be $4 million, $14.8 million, and $36.7 million respectively. This number is on the high-end, because we start the analysis with the basic assumption that we are starting from scratch with pedestrian infrastructure, when in fact we have a lot of infrastructure that remains serviceable, even though Atlanta's sidewalk infrastructure is in bad shape. In addition, the analysis assumes that the City will construct sidewalks where none currently exist (probably around 600 miles), and reasonable stakeholders can debate whether all of these sidewalks are needed.

Finally, four funding scenarios are presented for the sustainable sidewalk maintenance program. Scenario 1 followed the standard property tax approach for cost of entire sidewalk infrastructure where the average additional tax for low income community is $62. Scenario 2 is similar to Scenario 1 except private owners bear the cost for curb cut. The average cost for low income community in this case comes out to $178 per household. Scenario 3 and 4 also assumes the private ownership of curb cut. The city covers the cost

of curb ramps and the cost of sidewalk is split between the City and private property owners. Scenario 3 and 4 assumes the split of 50/50 and 60/40 respectively, between the City and private property owners. The average cost for low income community comes out to be $369 and $342 respectively.

The analysis suggests that low income households are much better off when sidewalk infrastructure cost is folded into the standard property tax approach. With each scenario, the burden on low income household kept getting worse. Scenario 4 tried to mitigate the impact on low income household by changing the split from 50/50 to 60/40 between the City and private property owners.

Because sidewalk infrastructure is a public good, it is difficult to argue that the sidewalks are the responsibility of the adjacent property owner. On the other hand, driveway curb cuts do provide access to private property and perhaps should be considered the responsibility of the property owner.

When local governments do not ensure the proper maintenance of the sidewalk infrastructure, sidewalks begin to fall into poor condition, and the neighborhoods lose the benefits of the walkable environment. The backlog of the sidewalk repairs piles up, resulting in a huge maintenance cost. Hence, it is necessary to establish a maintenance program for the sidewalk infrastructure to ensure the quality of sidewalks and to uphold a walkable environment in the neighborhood.

Most of the cities currently place the responsibility of sidewalk maintenance onto the adjacent property owner. However, as noted in this analysis, this places a significantly greater burden on low-income households in Atlanta. Furthermore, low-income property

owners may not be able to able to pay for these repair costs, and other property owners may simply care little about the walkable environment in the neighborhood and delay the repairs until sidewalk condition becomes critical. If the local government takes the responsibility for sidewalk maintenance, it could appoint staff to manage planning and execution of the maintenance program and may also benefit from bundling the sidewalk repairs.

6.1 Future Research

This research has disclosed many opportunities to further research on the sustainability of sidewalk infrastructure in terms of finance and equity. This research needs to be explored in two different area: 1) Project Prioritization, and 2) Funding Mechanism

The City of Atlanta is currently in contract with a private company in an effort to acquire the actual pedestrian infrastructure data for all the neighborhoods to make sure a city-wide equitable maintenance program exists. Such an approach will be necessary to refine data on sidewalk presence and condition.

Project prioritization is an important next step that has not been addressed in this research. Project prioritization methodologies assess how the funding should be spent based on accessibility, mobility, and safety concerns (59). Project prioritization should also include equity concerns to ensure all income class and ethnic group have easy access to good quality sidewalks.

The maintenance data was generalize based on the study of four corridor. A system-wide data collection effort is need to quantify each asset's location, condition, and repair maintenance cost to better estimate the equivalent annual cost for the sidewalks.

The research presents only a few funding options, and all the options involves additional financial burden on the residents. More federal/state funding options should be explored which could fund sidewalk construction and maintenance to create a walkable environment in the neighborhood.

APPENDIX A. AVERAGE INCOME INDEX, SIDEWALK MILES, NUMBER HOUSEHOLDS FOR EACH NEIGHBORHOOD

Neighborhood Name	Average Income Index	Sidewalk Miles	Number of Households
Adair Park	37.38	12.81	570
Adams Park	46.66	20.55	683
Adamsville	29.16	19.56	687
Almond Park	27.32	11.66	297
Amal Heights	26.20	1.82	149
Ansley Park	170.37	15.91	1222
Arden/Habersham	389.24	3.95	116
Ardmore	145.75	3.45	543
Argonne Forest	352.77	6.47	204
Arlington Estates	48.04	9.90	355
Ashley Courts	27.17	1.25	187
Ashview Heights	26.91	10.33	575
Atkins Park	128.50	2.14	265
Atlanta Industrial Park	40.93	9.08	28
Atlanta University Center	25.99	17.65	295
Atlantic Station	85.73	7.35	1289
Audobon Forest	86.84	11.34	228
Audobon Forest West	74.37	3.79	131
Baker Hills	40.49	7.33	352
Bakers Ferry	48.34	2.80	74
Bankhead	24.61	15.97	530
Bankhead Courts	15.98	1.58	41
Bankhead/Bolton	20.81	5.72	80
Beecher Hills	51.93	7.31	245
Ben Hill	51.68	13.60	463
Ben Hill Acres	43.50	2.70	80
Ben Hill Forest	47.88	2.29	50
Ben Hill Pines	38.95	2.42	80
Ben Hill Terrace	36.16	6.88	256
Benteen Park	68.39	7.02	284
Berkeley Park	70.04	11.88	624
Betmar LaVilla	33.76	3.97	321
Blair Villa/Poole Creek	39.45	16.05	1317
Blandtown	76.84	16.10	824
Bolton	90.23	24.55	1041
Bolton Hills	38.18	2.56	78

Boulder Park	42.06	3.92	90
Boulevard Heights	74.06	7.58	443
Brandon	380.46	11.78	314
Brentwood	47.88	2.10	77
Briar Glen	50.42	2.33	107
Brookhaven	268.56	19.58	826
Brookview Heights	35.00	7.90	25
Brookwood	90.23	4.51	1000
Brookwood Hills	255.00	7.58	492
Browns Mill Park	31.92	15.48	828
Buckhead Forest	113.84	6.39	1241
Buckhead Heights	108.35	2.30	937
Buckhead Village	99.52	6.19	1245
Bush Mountain	28.99	2.56	93
Butner/Tell	40.42	2.43	60
Cabbagetown	86.96	6.75	754
Campbellton Road	21.50	12.26	1456
Candler Park	155.16	18.92	1838
Capitol Gateway	22.84	4.11	311
Capitol View	37.12	17.48	852
Capitol View Manor	44.95	5.94	296
Carey Park	23.26	13.68	395
Carroll Heights	30.47	11.57	431
Carver Hills	26.03	7.59	264
Cascade Avenue/Road	36.19	20.14	858
Cascade Green	103.16	1.91	104
Cascade Heights	55.78	14.98	1119
Castleberry Hill	66.04	10.96	774
Castlewood	340.14	7.32	262
Center Hill	27.35	25.36	992
Chalet Woods	56.07	3.32	104
Channing Valley	136.48	3.42	184
Chastain Park	366.60	29.42	775
Chattahoochee	17.00	3.90	1
Chosewood Park	32.32	15.58	504
Collier Heights	37.71	47.69	1982
Collier Hills	183.29	7.29	294
Collier Hills North	159.49	2.85	126
Colonial Homes	94.94	1.19	504
Cross Creek	73.89	9.04	1336
Custer/McDonough/Guice	43.39	10.10	389
Deerwood	44.28	5.35	220

Dixie Hills	27.55	18.44	640
Downtown	57.46	65.50	4486
Druid Hills	193.05	11.60	653
East Ardley Road	55.63	2.71	96
East Atlanta	93.11	46.83	2472
East Chastain Park	141.96	11.97	1198
East Lake	121.46	30.03	1291
Edgewood	91.74	28.06	1999
Edmund Park	246.67	1.48	121
Elmco Estates	41.78	3.86	139
Englewood Manor	27.91	1.37	23
English Avenue	30.67	30.11	902
English Park	32.03	3.75	73
Fairburn	31.59	5.04	119
Fairburn Heights	31.15	10.81	370
Fairburn Mays	27.22	7.39	736
Fairburn Road/Wisteria Lane	45.76	2.15	41
Fairburn Tell	84.95	3.99	40
Fairway Acres	48.93	3.32	153
Fernleaf	181.30	2.26	93
Florida Heights	31.61	11.48	443
Fort McPherson	51.98	14.56	57
Fort Valley	20.36	0.07	101
Garden Hills	133.93	20.26	2664
Georgia Tech	56.67	15.23	45
Glenrose Heights	25.54	24.88	1142
Grant Park	101.29	54.35	3385
Green Acres Valley	59.54	2.40	78
Green Forest Acres	50.19	3.77	127
Greenbriar	34.09	28.68	1375
Greenbriar Village	56.98	1.72	89
Grove Park	27.35	46.32	1717
Hammond Park	22.18	14.98	636
Hanover West	226.80	3.68	159
Harland Terrace	23.83	8.04	741
Harris Chiles	17.24	3.93	245
Harvel Homes Community	42.67	0.94	46
Heritage Valley	51.08	9.31	340
High Point	55.49	3.49	160
Hills Park	136.42	21.80	543
Home Park	63.21	22.70	1922

Horseshoe Community	87.30	1.19	33
Hunter Hills	31.42	17.77	1173
Huntington	107.58	1.32	40
Inman Park	120.17	22.35	2295
Ivan Hill	55.12	1.68	60
Joyland	23.79	4.69	239
Just Us	36.59	1.01	39
Kings Forest	46.47	11.90	528
Kingswood	436.44	10.67	220
Kirkwood	106.03	46.33	3021
Knight Park/Howell Station	89.67	12.06	309
Lake Claire	200.16	15.88	1115
Lake Estates	58.92	1.05	53
Lakewood	29.29	11.73	446
Lakewood Heights	29.79	29.75	1067
Laurens Valley	62.60	3.78	120
Leila Valley	20.23	8.67	283
Lenox	129.36	7.25	127
Lincoln Homes	29.67	6.69	276
Lindbergh/Morosgo	60.31	15.14	2364
Lindridge/Martin Manor	78.52	16.39	2343
Loring Heights	89.33	10.73	880
Magnum Manor	79.15	5.69	170
Margaret Mitchell	283.37	16.01	437
Marietta Street Artery	49.46	6.42	560
Mays	46.31	2.86	358
Meadowbrook Forest	48.82	2.43	79
Mechanicsville	35.15	25.21	1977
Mellwood	40.18	0.78	38
Memorial Park	280.06	3.48	129
Midtown	97.76	52.61	13062
Midwest Cascade	116.71	20.48	649
Monroe Heights	37.79	5.56	308
Morningside/Lenox Park	192.75	56.06	3697
Mozley Park	29.56	14.60	671
Mt. Gilead Woods	45.51	1.57	76
Mt. Paran Parkway	347.56	2.63	66
Mt. Paran/Northside	357.34	30.73	555
Niskey Cove	100.67	1.97	67
Niskey Lake	115.00	7.52	67
North Buckhead	159.51	60.98	5670
Norwood Manor	27.67	7.16	216

Oakcliff	28.62	2.11	69
Oakland	69.93	1.81	145
Oakland City	30.94	29.75	2064
Old Fairburn Village	53.76	0.92	29
Old Fourth Ward	70.32	44.72	5710
Old Gordon	20.50	2.03	103
Orchard Knob	28.01	10.55	228
Ormewood Park	110.35	26.23	1888
Paces	203.36	41.06	1319
Peachtree Battle Alliance	291.33	15.33	522
Peachtree Heights East	188.66	6.54	510
Peachtree Heights West	127.61	16.36	2612
Peachtree Hills	144.25	13.92	1590
Peachtree Park	199.72	11.96	606
Penelope Neighbors	28.97	5.86	200
Peoplestown	34.43	16.97	881
Perkerson	25.80	20.00	818
Peyton Forest	64.52	9.17	288
Piedmont Heights	111.28	12.52	1154
Pine Hills	102.79	29.50	3359
Pittsburgh	24.75	27.66	1206
Pleasant Hill	305.82	5.75	95
Polar Rock	29.16	12.05	374
Pomona Park	40.98	2.20	107
Poncey-Highland	103.02	11.53	1236
Princeton Lakes	70.11	15.06	1084
Randall Mill	294.71	6.21	185
Rebel Valley Forest	26.03	3.73	126
Regency Trace	154.40	2.34	89
Reynoldstown	74.25	19.87	1384
Ridgecrest Forest	36.47	3.29	165
Ridgedale Park	130.74	4.54	691
Ridgewood Heights	170.29	4.70	196
Riverside	88.90	19.55	670
Rockdale	69.96	7.10	187
Rosedale Heights	24.69	5.64	362
Rue Royal	31.04	1.23	47
Sandlewood Estates	57.29	2.88	161
Scotts Crossing	24.90	7.54	365
Sherwood Forest	278.60	5.76	189
South Atlanta	27.47	15.32	468
South Oakes at Cascade	66.92	0.54	63
South River Gardens	31.62	25.95	759

South Tuxedo Park	167.71	10.04	591
Southwest	45.45	36.59	1339
Springlake	238.94	7.51	421
Summerhill	53.03	18.13	793
Swallow Circle/Baywood	29.14	4.94	174
Sweet Auburn	36.81	10.68	927
Sylvan Hills	32.25	40.34	1725
Tampa Park	40.79	0.83	33
The Villages at Carver	18.36	4.65	388
The Villages at Castleberry Hill	22.15	3.09	267
The Villages at East Lake	40.89	5.33	475
Thomasville Heights	21.65	17.01	754
Tuxedo Park	320.77	17.21	445
Underwood Hills	95.25	25.91	1434
Venetian Hills	30.72	26.22	1344
Vine City	27.04	21.80	1036
Virginia Highland	139.99	34.23	4126
Washington Park	28.93	9.07	475
Wesley Battle	348.62	5.78	173
West End	34.75	33.89	1915
West Highlands	51.21	9.74	536
West Lake	27.77	7.78	338
West Manor	57.89	6.27	187
West Paces Ferry/Northside	318.54	14.42	401
Westhaven	40.25	6.07	198
Westminster/Milmar	237.67	3.69	141
Westover Plantation	105.07	2.03	274
Westview	36.68	20.55	1146
Westwood Terrace	35.81	7.18	318
Whitewater Creek	290.04	6.86	112
Whittier Mill Village	134.40	8.35	411
Wildwood (NPU-C)	115.89	9.18	1330
Wildwood (NPU-H)	32.30	4.42	352
Wildwood Forest	49.16	2.93	117
Wilson Mill Meadows	43.66	8.92	369
Wisteria Gardens	37.50	4.59	209
Woodfield	327.37	1.88	49
Woodland Hills	89.16	3.78	205
Wyngate	370.55	4.90	138

APPENDIX B. NUMBER OF HOUSEHOLDS FOR EACH ETHNICITY IN THE NEIGHBORHOODS

Neighborhood Name	A	B	C	D	E	F	G	H	I	J	K	L	O	Y	Z	Grand Total
Adair Park	462	12	4		14		4		5	7	43	7		12		570
Adams Park	623	6	2		3		6		4	6	24	3		5		682
Adamsville	627	2	1		3		5		6	6	21	2		14		687
Almond Park	253	5	2		1		1		3		21			11		297
Amal Heights	138						2		1	1	3	1		3		149
Ansley Park	40	17	4	1	54	1	23	3	14	60	954	29		22		1222
Arden/Habersham	3		2		4		3	2	1	2	97	1		1		116
Ardmore	22	12	5		17		11	2	4	22	407	20		21		543
Argonne Forest	7	2			9		1		3	6	171	3		2		204
Arlington Estates	331						3	2	3	3	8	1		4		355
Ashley Courts	166	1	1		1		1		2	3	8			4		187
Ashview Heights	508	5			3		4	1	7	10	26	3		8		575
Atkins Park	13	4	4		13		5		1	13	194	7		11		265
Atlanta Industrial Park	22	1								2	1			2		28
Atlanta University Center	266		1		2		1		1	7	9	2		6		295
Atlantic Station	383	114	74	3	38		12	7	41	27	487	30	1	72		1289

Audobon Forest	210				2				2	2	6	1		4		227
Audobon Forest West	123				1					1	5			1		131
Baker Hills	328	1			1		1		1	2	11	1		6		352
Bakers Ferry	66	1			1					1	4			1		74
Bankhead	492	3	1	1	6		3		3	5	6			10		530
Bankhead Courts	41															41
Bankhead/Bolton	78						1				1					80
Beecher Hills	220				2		4		3	5	9			1		244
Ben Hill	417	5	1		2		7	1	2	5	17			6		463
Ben Hill Acres	76		1							1		1		1		80
Ben Hill Forest	44	1			1		1				2			1		50
Ben Hill Pines	76										1			3		80
Ben Hill Terrace	223				1		2		4	3	20	1		1		255
Benteen Park	195	4			4	1	5	3	5	4	25	5		33		284
Berkeley Park	397	30	5		18		9	1	9	9	104	8		34		624
Betmar LaVilla	280	7	1		1				3	7	17	1		4		321
Blair Villa/Poole Creek	481	14	1		7	1	11	2	15	19	737	10		19		1317
Blandtown	433	36	14	1	28		13	2	15	23	200	17		42		824
Bolton	650	28	15	1	32		12	2	11	25	129	21		115		1041
Bolton Hills	71				1		2				4					78
Boulder Park	84									2	2			2		90

Boulevard Heights	310	6			11		2		6	8	59	13		28		443
Brandon	9	6	8		9		5		5	19	240	8		5		314
Brentwood	74										1			2		77
Briar Glen	98					1	2			3	2			1		107
Brookhaven	9	14	5	4	28		12	1	4	41	677	14		17		826
Brookview Heights	21									1	3					25
Brookwood	55	31	15		33	2	9	2	19	34	729	25		46		1000
Brookwood Hills	8	7	3		15	1	9		3	18	410	11		7		492
Browns Mill Park	753	1			5	1	4		5	13	21	4		21		828
Buckhead Forest	52	23	19	3	50	3	17	4	16	64	897	43		49		1240
Buckhead Heights	49	29	32	1	47	1	18	3	20	42	611	23		61		937
Buckhead Village	54	37	33	4	52	1	20	1	23	56	850	34		80		1245
Bush Mountain	80	3			2		2		1	2	2			1		93
Butner/Tell	52						3			1	3	1				60
Cabbagetown	495	10	6	1	30	1	12	2	9	28	113	20		27		754
Campbellton Road	1348	6			5		13	2	5	14	38	2		22		1455
Candler Park	127	35	12	3	68		28	2	11	67	1362	57	1	64	1	1838
Capitol Gateway	264	6	1		3		2	1	2	4	22	2		4		311
Capitol View	728	10	2		13		6		7	8	51	9		17		851

Capitol View Manor	254		3		1		6			9	19			4		296
Carey Park	349	4				1	7		3	7	12	1		11		395
Carroll Heights	394	2	2		1		1		2	10	13	1		5		431
Carver Hills	236	3			2	1	3		2		14	1		2		264
Cascade Avenue/Road	780	4					6		4	17	30	3		14		858
Cascade Green	91						1		1	1	9			1		104
Cascade Heights	1021	12			5	2	9	1	9	11	35	4		9		1118
Castleberry Hill	359	14	9		17		9		6	12	304	20		24		774
Castlewood	7	1	2	1	3	1	3		1	9	228	5		1		262
Center Hill	906	10	4		2		7	2	8	13	20	3		17		992
Chalet Woods	96	1								2	3			2		104
Channing Valley	115	9	2		6		3		1	3	35	4		6		184
Chastain Park	10	13	10	2	18	2	14	2	8	51	612	18		15		775
Chattahoochee	1															1
Chosewood Park	370	6	2		7	1	2		1	10	58	5		42		504
Collier Heights	1818	16	5		4		19		11	27	52	8		22		1982
Collier Hills	174	3	2		13		5		1	12	74	4		6		294
Collier Hills North	2	4			4		3	2		4	101	4		2		126
Colonial Homes	30	9	3	1	24		10		4	22	364	16		21		504

Cross Creek	111	32	15	1	40	1	20	1	17	44	986	25		43		1336
Custer/McDonough/Guice	292	4					4		7	7	28	7		39	1	389
Deerwood	206	3	1				1		1	4	2	1		1		220
Dixie Hills	576	6	1		4		5		2	10	14	2		20		640
Downtown	1819	106	56	3	106	2	55	9	73	108	1915	77		157		4486
Druid Hills	21	13	13	1	22	1	7	2	5	36	494	17		21		653
East Ardley Road	95	1														96
East Atlanta	1828	31	15	1	52		37	5	21	68	285	51		78		2472
East Chastain Park	38	21	25		34	2	15	1	14	67	901	39		41		1198
East Lake	960	12	7	4	29		13	2	11	34	173	21		25		1291
Edgewood	669	24	24	4	45	3	29	4	22	50	1008	41	1	74	1	1999
Edmund Park	3	3	2		6		3		1	10	84	3		6		121
Elmco Estates	130				1		1			1	3	2		1		139
Englewood Manor	20										3					23
English Avenue	749	17	7		9	1	10		5	16	58	5		25		902
English Park	65	1	1							1	1	1		3		73
Fairburn	115	1								2				1		119
Fairburn Heights	333				3		4		2	4	8	3		13		370
Fairburn Mays	679	3	3		2		5		5	6	25	1		7		736
Fairburn Road/Wisteria Lane	36						1				4					41
Fairburn Tell	34						1		1	1	1	1		1		40

Fairway Acres	147						1				3			2		153
Fernleaf	65	4			1		1		3	5	9	1		4		93
Florida Heights	397	2	2		9		4		3	1	16	2		7		443
Fort McPherson	46	1			2					3	1			4		57
Fort Valley	93	2							1	1	3			1		101
Garden Hills	138	31	21	2	93	4	45	3	39	74	2036	57		121		2664
Georgia Tech	8	2	2		1		1		1	3	21	3		3		45
Glenrose Heights	1023	12			2	1	11		10	17	39	6		20		1141
Grant Park	2340	49	30	1	111	1	53	6	26	99	477	91		101		3385
Green Acres Valley	74	1								1	2					78
Green Forest Acres	120		1				1		1	2	1		1			127
Greenbriar	1247	5	3		4		6	2	7	22	62	3		14		1375
Greenbriar Village	86									2	1					89
Grove Park	1560	16	2		11		13	1	4	18	57	2		33		1717
Hammond Park	532	11	2		5		4		4	5	31	3		39		636
Hanover West	28	5	2		2		2		2	5	112			1		159
Harland Terrace	682	6	1		1	1	3	1	4	15	18	1		8		741
Harris Chiles	226	1	1		1		1			5	7	1		2		245
Harvel Homes Community	41	1					1				1	1		1		46

Heritage Valley	330				1		1			5	2	1				340
High Point	135	3	1		2				2	3	8	3		3		160
Hills Park	360	7	6	1	15		4		4	23	85	16		22		543
Home Park	1079	111	91	1	50	2	41	3	80	57	266	41		91	1	1914
Horseshoe Community	30								1		1			1		33
Hunter Hills	1053	11	3	1	10		9		11	24	36	4		11		1173
Huntington	36							1		1	1			1		40
Inman Park	121	41	40	1	94	2	56	2	20	106	1679	63		70		2295
Ivan Hill	57	1					1		1							60
Joyland	217	2					4			1	5			10		239
Just Us	34				1		1			1	2					39
Kings Forest	481	1					8	1	8	7	14	1		7		528
Kingswood	6	3	5		7	1	4		3	12	172	4		3		220
Kirkwood	2111	37	20		73	2	46	2	18	95	442	86		89		3021
Knight Park/Howell Station	225	7	3		11		6	2		4	35	6		10		309
Lake Claire	44	15	10		44		13	2	8	46	867	40		26		1115
Lake Estates	48						1			3	1					53
Lakewood	404	4	1			1	2		3	5	8			18		446
Lakewood Heights	924	15	2		6		12	1	13	14	43	2		33		1065
Laurens Valley	109						2			3	6					120
Leila Valley	207	3	1		4		3		3	2	6			54		283
Lenox	2	4			2		3		3	13	95	2		3		127
Lincoln Homes	248		2				3		1	1	14	1		5	1	276

Lindbergh/Morosgo	234	107	79	2	83	2	25	5	33	77	1492	60		163	2	2364
Lindridge/Martin Manor	208	86	34	2	84	4	21	5	35	70	1569	59		162		2339
Loring Heights	158	39	13		17		12	1	10	23	537	26		43	1	880
Magnum Manor	159	1	1				3				6					170
Margaret Mitchell	25	14	8	1	8		8	1	6	38	312	7		9		437
Marietta Street Artery	218	20	11		12		7	1	10	12	242	4		23		560
Mays	311	1			4		2		2	3	30			5		358
Meadowbrook Forest	74						1		2		1			1		79
Mechanicsville	1450	21	4		17		12	1	15	27	383	6	1	37		1974
Mellwood	35						1				2					38
Memorial Park	39	2	1		2		3			5	74	1		2		129
Midtown	846	430	320	16	500	11	193	26	236	475	8954	398		652	2	13059
Midwest Cascade	591	6	2		2		2		2	7	26	6		5		649
Monroe Heights	269	3			3	1	4		4	9	9	1		5		308
Morningside/Lenox Park	123	76	47	4	146	2	67	4	39	198	2771	105	1	113	1	3697
Mozley Park	596	4	2		4		8		5	11	27	5		9		671
Mt. Gilead Woods	73		1		1						1					76

Mt. Paran Parkway	2	1					2			6	49	2		4		66
Mt. Paran/Northside	13	13	18	3	28		7		8	33	405	10		17		555
Niskey Cove	60										7					67
Niskey Lake	59	1			1				1	2	2			1		67
North Buckhead	224	184	132	10	196	3	83	11	119	321	3947	196		238	3	5667
Norwood Manor	195	1			1					6	7			6		216
Oakcliff	64				1					2	1			1		69
Oakland	92	2			6		2		3	2	29	6		3		145
Oakland City	1822	11	10	1	14		18	2	10	30	97	8		41		2064
Old Fairburn Village	27										1			1		29
Old Fourth Ward	2449	136	102	5	180	3	94	17	75	166	2124	118		238	2	5709
Old Gordon	84	1			2	1	1				5			9		103
Orchard Knob	203	4	1		1		1			4	6			8		228
Ormewood Park	1313	25	19		56		34	2	10	53	241	42		68	1	1864
Paces	57	38	16	2	47	2	24		16	55	1001	26		35		1319
Peachtree Battle Alliance	10	5	1		8		5		4	14	466	5		4		522
Peachtree Heights East	9	2	1		17	1	6		3	27	426	10		8		510
Peachtree Heights West	124	51	35	6	86		48	8	56	119	1920	62		97		2612

Peachtree Hills	53	39	11		58	1	24	3	25	54	1207	46		68		1589
Peachtree Park	13	8	7		24		10	1	1	21	480	22		19		606
Penelope Neighbors	183	3			1				2		6	1		4		200
Peoplestown	726	9	4		12	2	10		6	16	58	6		32		881
Perkerson	688	16	2		8		7		2	9	31	1		54		818
Peyton Forest	266	1	1		2		3			1	10	1		3		288
Piedmont Heights	68	34	11		40	2	24	3	14	42	823	39		53	1	1154
Pine Hills	190	172	99	9	133	1	50	13	89	130	2192	99		182		3359
Pittsburgh	1018	20	5		9	2	17	2	14	18	69	5		26		1205
Pleasant Hill	3	1	1		2		6		1	7	71	2		1		95
Polar Rock	327	5	1		2		2	1	4	3	9			20		374
Pomona Park	97	1			1	1					4			3		107
Poncey-Highland	66	30	18	4	42	1	25	1	13	55	910	32		39		1236
Princeton Lakes	883	17	2		5		5	3	6	13	109	6		35		1084
Randall Mill	2	3	1		4		3		3	13	148	3		4		184
Rebel Valley Forest	111		1				2		3	1	1	1		6		126
Regency Trace	86						1			1	1					89
Reynoldstown	855	33	14	1	47	1	21	2	23	52	244	35		56		1384
Ridgecrest Forest	152				1					2	3	2		5		165
Ridgedale Park	14	20	12		21	1	10		5	33	528	15		32		691

Ridgewood Heights	133	2			6		5		1	7	33	5		4		196
Riverside	458	12	6		14		10	1	6	14	99	13		36	1	670
Rockdale	134	8	1		1		1		1	4	27	3		7		187
Rosedale Heights	333	4			1		3		3	4	7	1		6		362
Rue Royal	42						1				3			1		47
Sandlewood Estates	148	2			1		1		2	2	4			1		161
Scotts Crossing	321	1	2	1	4		3		2	4	20	1		6		365
Sherwood Forest	2	5	2		7		3		4	10	146	8		2		189
South Atlanta	411	6	2		4		5		3	7	19	4		7		468
South Oakes at Cascade	53				1					1	7			1		63
South River Gardens	680	6	3		5		6		4	13	16	4		22		759
South Tuxedo Park	12	7	5	1	18		6	3	7	20	467	17		28		591
Southwest	1219	4	2		3		6	1	7	21	58	4		14		1339
Springlake	225	6	1		10		10		1	18	136	5		9		421
Summerhill	620	15	8		13		10		12	21	64	14		16		793
Swallow Circle/Baywood	158				2		1		2	2	2	1		6		174
Sweet Auburn	670	14	9		17		9	2	12	19	132	11		32		927
Sylvan Hills	1503	10	3		22		16	5	12	18	84	16		36		1725
Tampa Park	31	1					1									33

The Villages at Carver	350	2	2		4		3		4	3	18			2		388
The Villages at Castleberry Hill	231		2		2				2	6	18	1		5		267
The Villages at East Lake	421	3	1		5	1	2		7	2	27	1		5		475
Thomasville Heights	696	6	2		1		3	1	2	15	13	1		14		754
Tuxedo Park	7	5	7	1	16		4	2	7	24	356	9		7		445
Underwood Hills	874	43	18	1	44	2	25	4	10	55	254	44		60		1434
Venetian Hills	1237	7	1		7		7	2	7	18	40	5		13		1344
Vine City	919	9	4	1	2	3	12		8	11	46	4		17		1036
Virginia Highland	160	76	44	3	160		70	5	33	183	3120	128		144		4126
Washington Park	427	5	1		2		6		1	8	17	2		5	1	475
Wesley Battle	4	2	3		2		3		3	9	142	3		2		173
West End	1628	23	7	1	14		21	3	25	25	118	20		30		1915
West Highlands	412	10	5		5		6		8	5	63	6		16		536
West Lake	295	4					4		5	5	14	1		10		338
West Manor	177	1					1			1	4			3		187
West Paces Ferry/Northside	7	3	4		10		4		10	18	326	12		7		401
Westhaven	183	1			1					1	8			4		198
Westminster/ Milmar	2	5	4	1	6		1	1	3	6	108	2		2		141

Westover Plantation	186	5	2		3	1	4	1	2	13	38	7		12		274
Westview	981	10	5		8		7		7	21	77	7		23		1146
Westwood Terrace	286	3	1		1		3		2	2	15	2		3		318
Whitewater Creek	7	2	1		1		5		1	5	88			2		112
Whittier Mill Village	267	7	5		12		13		3	9	77	7		11		411
Wildwood (NPU-C)	569	25	13	2	36		19	2	9	37	545	29		44		1330
Wildwood (NPU-H)	330	3			1		3		2	3	6			4		352
Wildwood Forest	109					1	1	1		1	2			2		117
Wilson Mill Meadows	350	1			1		3		2	3	3			6		369
Wisteria Gardens	189	2			2		1		2	3	3			7		209
Woodfield	2				1		1			2	42	1				49
Woodland Hills	139	3	1	1	5		2		1	10	22			6		190
Wyngate	4	1	1		7					5	116	3		1		138
Grand Total	82960	3405	1967	127	4091	97	2248	251	1998	5065	65650	3157	6	5863	20	176905

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